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A Study of the Validity of the Dyer Backboard Test and the Miller Forehand-Backhand Test for Beginning Tennis Players

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THE DEPARTMENT of Physical Education for Women at the University of Washington for the past four years has been attempting, through several sports committees, to standardize minimum course content, knowledge grades, and skill grades in various activities. One of the functioning committees has been the Tennis Committee* which to date has established course content for beginning classes and has outlined analyses of the various skills included in beginning tennis classes. For evaluating knowledge, a revision of the Miller Comprehensive Tennis Examination[1] has been used.

One of the major problems has been that of skill grading. There often are as many as ten sections in beginning tennis, and in the past two years seven different instructors have taught beginning tennis. It was deemed desirable, for the purpose of assigning a skill grade, to find or devise some objective measure of tennis playing ability in order to standardize as much as possible the grading in the different sections and among the different instructors. It was important also that the test or tests be easily administered and that they consume a minimum of class time.

A review of the literature indicates that the validity studies of the Dyer Backboard Test[2] have shown a variety of coefficients depending on the criteria and the group used. The specific skill levels of the groups used in the validity studies are not reported. It is conceivable that a test could prove valid for a highly skilled group and for a group with a wide range of ability and not discriminate with the same degree of efficiency between players at the lower levels of ability. Since the Tennis Committee, at this time, was interested in finding an objective test of tennis playing ability for beginning players, further investigation of the Dyer Backboard Test was suggested.

The study of the Miller test[3] reported a validity coefficient of .61 for beginners. This is slightly low for confidence. The test did prove more valid for intermediate players (.85). The subjective judgment rating used in determining this validity was based on each judge's ranking of the individuals in the study.

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* Other members of the Tennis Committee are: Kathro Kidwell, Helen McLellan, Leone Rulifson, Ellen Waters, and Virginia Wolf.

[1] Marion R. Broer and Donna Mae Miller. "Achievement Tests for Beginning and Intermediate Tennis." *Research Quarterly* 21 (3): 303-321, (October 1950).

[2] Joanna Thayer Dyer. "The Backboard Test of Tennis Ability." *Research Quarterly*, 6 (1): 63-74, Supplement (March 1935).

[3] Marion R. Broer and Donna Mae Miller. *op. cit.*, p. 311-312.

The judges felt that ranking was not an entirely successful method of rating the players, and that their judgments would have been more valid if some other means had been used. Accordingly, it was decided to study further the validity of the Miller test for beginning tennis players when a subjective rating on the basis of a previously determined point scale was used.

It is the purpose of this article to present some of the statistical data gathered on a group of beginning tennis players who were subjectively rated in playing ability by four judges and to whom the Miller[4] and the Dyer[5] tennis tests were administered.

Procedure

In the spring quarter, 1951, four beginning tennis classes were selected to be used for the purposes of this study. Each class met a minimum of one-half hour twice a week for ten weeks. During the eleventh week each class had a regular two-hour examination period as scheduled by the University. Three of the four classes had a different instructor. All students were beginners in tennis. The total number in the four classes was 84. Throughout the quarter two of the classes (total 43 students) were given backboard practice as part of their instruction. In the other two sections (41 students) no backboard practice was allowed at any time during the class.

SUBJECTIVE RATING OF THE STUDENTS

Four instructors who have had a great deal of experience in teaching tennis were selected to act as judges of the playing ability of the students in these classes. The Departmental Tennis Committee has listed the practical skills to be taught and practised in beginning tennis classes as the courtesy stroke, the forehand drive, the backhand drive, and the serve. An analysis of these strokes also is included in the material on course content. Previous to the time when the students were to be rated on playing ability, the judges, on the basis of these analyses, assigned relative values to the various elements of the strokes as used in a game situation. It was decided that the following factors should be considered in the forehand and backhand drive:

1. Waiting position
2. Anticipation and moving into position
3. Stroke execution
4. Ball flight

If these strokes, the forehand and backhand drives, were performed in excellent form the student would be given 24 points to which waiting position contributed four points; anticipation and moving, four points; stroke execution, ten points; and ball flight, six points. These point values set up by the judges were submitted to the Tennis Committee for approval. It was felt that these point values represented the relative importance of the different phases of the forehand and backhand drives in the successful performance of a beginning

[4] *Ibid*

[5] Joanna Thayer Dyer. "Revision of the Backboard Test of Tennis Ability." *Research Quarterly*. 9 (1): 25–31 (March 1938).

tennis player. The judges reviewed the analyses of the techniques as written by the Tennis Committee, and as a result there was an understanding of the types of performance that were desired. For example, in considering stroke execution, all the items (such as, taking the backswing while moving into position, using a flat backswing, transfer of weight, point of ball contact, follow-through, etc.) that were listed by the Tennis Committee were discussed at length by the judges. For any defect in any part of the performance each judge deducted the number of points which corresponded to the gravity of the imperfection in performance.

On the serve, the elements considered were:

1. Preliminary position
2. Ball toss
3. Execution
4. Ball flight

Of the possible maximum total of 24 points on the serve, preliminary position could contribute three points; ball toss, six points; execution, ten points; and ball flight, five points.

The judges then devised a chart which contained this information. Prior to rating the playing ability of the students in the classes selected for the purposes of this study, each judge studied the chart and practised using it in some class not being used in this study. This was done to help familiarize the judges with the chart so that they could use it more effectively and more rapidly and more easily record their ratings.

Since the skill objectives for beginning tennis classes as determined by the Tennis Committee are the learning of the forehand drive, the backhand drive, and the serve, and since the committee was attempting to find an objective test or tests that would measure the students' ability to use these strokes in a game situation, the judges' subjective ratings were made on the basis of these three strokes as the students played a game of tennis. Therefore, the students' playing ability was measured only in terms of the extent to which they successfully executed these three strokes in a game situation.

The actual rating of tennis playing ability of the students in the four selected classes was done during the last two class periods. As the students played a game of doubles, the judges rated their performance as occasion arose for them to use the drives and the serve. All the judges watched the same four players at the same time. The final subjective rating of any student was the sum of the scores on the forehand drive, the backhand drive, and the serve.

OBJECTIVE TESTING OF THE STUDENTS

During the final two-hour examination period, the students in the four beginning tennis classes selected for this study were given the Dyer test[6] and the Miller Forehand-Backhand test.[7] These were administered according to the directions given for the tests.

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[6] *Ibid.*

[7] Marion R. Broer and Donna Mae Miller. *op. cit.*

Treatment of the Data

Correlation coefficients were calculated for:

1. Subjective ratings of Judge one with two, three and four.
2. Subjective ratings of Judge two with three and four.
3. Subjective ratings of Judge three with four.
4. The subjective ratings of each judge with the Dyer test scores
   (a) For the group with no backboard practice
   (b) For the group with backboard practice
   (c) For the total group
5. The subjective ratings of each Judge with the Miller test scores
   (a) For the group with no backboard practice
   (b) For the group with backboard practice
   (c) For the total group
6. The average subjective ratings of the four judges with the Dyer test scores
   (a) For the group with no backboard practice
   (b) For the group with backboard practice
   (c) For the total group
7. The average subjective ratings of the four judges with the Miller test scores
   (a) For the group with no backboard practice
   (b) For the group with backboard practice
   (c) For the total group
8. The Dyer test scores with the Miller test scores
   (a) For the group with no backboard practice
   (b) For the group with backboard practice
   (c) For the total group
9. The average subjective ratings of the four judges with the Dyer test scores plus the Miller test scores
   (a) For the group with no backboard practice
   (b) For the group with backboard practice

Discussion of Results

Table 1 shows the intercorrelations of the subjective ratings of the four judges. These correlations indicate that the judges' ratings of playing ability are fairly reliable. The average rating of judges one and two was correlated with the average rating of judges three and four and found to be .88 $\pm$.018. Since this is considerably higher than the correlation coefficient between any two

TABLE 1

Intercorrelation of Subjective Judgment[1]

Judge	2		3		4	
	r	P.E.	r	P.E.	r	P.E.
1	.79	.028	.76	.031	.78	.029
2			.77	.030	.84	.022
3					.78	.029

[1] Number of cases—84.

judges and since it is generally agreed that an average of four judges' ratings is more reliable than the rating of any one judge, the average rating of these four judges should prove a reliable measure of the tennis ability of the students in this study.

Table 2 gives the results of the correlations between the Dyer and the Miller tests. The correlations of .69 between the Dyer test and the total Miller test when no backboard practice was allowed, and .37 when backboard practice was used indicate that, while there is some overlapping, the two tests measure different elements in the ability to execute the forehand drive, the backhand drive, and the serve in a game situation; and that backboard practice increases the extent to which these differences are measured. These results were checked by correlating the scores of the two groups for all beginning classes regardless of whether or not they were used in the validity study. For 115 cases the coefficient of correlation between the two tests was found to be .66 when no backboard practice was allowed and .38 when backboard practice was used.

Table 3 summarizes the results of the correlation of the subjective ratings with the Dyer test. In every case, but one, there is a higher correlation between the subjective ratings and the Dyer test in the classes where backboard practice had been allowed, but these differences are not significant. The data obtained in this study indicate that in no case was the correlation between the Dyer test and the ability to execute the forehand drive, the backhand drive, and the serve in a game situation as measured by any one judge or the average of all four judges sufficiently high to warrant the use of the Dyer test as a single measure of a beginner's ability to use these strokes in a game situation.

TABLE 2

Correlation Coefficients Between Dyer and Miller Test Scores

No Backboard Practice			Backboard Practice Number			Total		
Number	r	P.E.	Number	r	P.E.	Number	r	P.E.
41	.69	.055	43	.37	.088	84	.51	.054
47	.66	.055	68	.38	.070	115	.46	.050

TABLE 3

Correlation Coefficients between Subjective Ratings and Dyer Test Scores

Judge	No Backboard Practice		Backboard Practice		Total	
	r	P.E.	r	P.E.	r	P.E.
1	.45	.084	.51	.076	.48	.056
2	.47	.082	.49	.078	.47	.057
3	.42	.087	.46	.081	.42	.060
4	.50	.079	.41	.085	.45	.058
Average of four judges	.51	.078	.57	.069	.53	.053
Number of cases	41		43		84	

Table 4 shows the correlations between the Miller test and the subjective ratings of the judges. In all cases the correlation between the subjective scores and the Miller test scores was higher when backboard practice had been allowed during the instructional period. The difference between the correlations of the average subjective judgment and the test scores for the two groups is significant at the 1 per cent level of confidence. The correlation between the average subjective rating of the four judges and the Miller test (.79) is sufficiently high that the Miller test can be considered a fairly valid measure of a beginner's ability to use the forehand drive, the backhand drive, and the serve in a game situation, if the students have practiced against a backboard. The difference between this coefficient of correlation and that for the Dyer test with the backboard group is significant at the 6 per cent level of confidence only.

Table 5 gives the correlations between the average subjective ratings of the judges and the Dyer plus the total Miller. For the group that had had backboard practice the correlation of .81 between the average subjective rating of the judges and the Dyer plus the total Miller indicates that a combination of scores on these two tests would give a valid measure of a beginner's ability to use the forehand drive, the backhand drive, and the serve in a game situation.

TABLE 4

Correlation Coefficients between Subjective Ratings and Miller Test Scores

Judge	No Backboard Practice		Backboard Practice		Total	
	r	P.E.	r	P.E.	r	P.E.
1	.52	.077	.68	.055	.59	.048
2	.49	.080	.72	.049	.62	.045
3	.32	.095	.68	.055	.47	.057
4	.32	.095	.58	.068	.45	.058
Average of four judges	.46	.083	.79	.038	.61	.046
Number of cases	41		43		84	

TABLE 5

Correlation Coefficients Between Average Subjective Judgment and Total Dyer and Miller Test Scores

No Backboard Practice			Backboard Practice		
Number	r	P.E.	Number	r	P.E.
41	.51	.078	43	.81	.035

Conclusions

1. On the basis of the subjective ratings of the judges in this situation, backboard practice seems to make both the Dyer and the Miller tests better measures of beginners' ability to use the forehand drive, the backhand drive, and the serve in a game situation.

2. The relatively low correlations between the Dyer and the Miller tests indicate that the two tests are not measuring entirely the same things.

3. The inter-correlations of the subjective ratings of the four judges were sufficiently high that an average of the four judgments can be considered to be reliable.

4. The correlations between the average subjective ratings of the judges and the Dyer test, even in the classes where backboard practice had been included in the learning process, were not high enough to justify the use of the Dyer test as a single measure of beginners' ability to use the forehand drive, the backhand drive, and the serve in a game situation.

5. The correlation between the average subjective rating of the judges and the Miller test in the classes where backboard practice had taken place was .79. This indicates that, when backboard practice has taken place, the Miller test can be used with a fair degree of confidence, as a measure of beginners' ability to use the forehand drive, the backhand drive, and the serve in a game situation.

6. The correlation of .81 between the average subjective rating of the judges and the Dyer plus the total Miller, when backboard practice was used, would indicate that when these tests are used in combination they constitute a valid measure of beginners' ability to use the forehand drive, the backhand drive, and the serve in a game situation. This holds true, however, only in classes where backboard practice has been included as a teaching device.

7. With the group that had had backboard practice, the difference between the correlations of the average subjective rating with the Miller test alone (.79) and the average subjective rating with the Dyer and Miller combined (.81) is not significant.

Need for Further Study

The objective evaluation of skill in playing tennis as measured by either the Dyer or Miller tests or by a combination of the two tests completely disregards the use of the serve. Since it is the desire of the Tennis Committee to find a test or tests which will determine beginners' ability to use the forehand drive, the backhand drive, and the serve in a game situation, the criterion was set up to include all these strokes as they were used while playing a game. With such a criterion a validity coefficient of .79 (Miller test alone) or .81 (Miller plus the Dyer) may be as high as can be expected when a measure of the ability to serve is not taken into consideration.

Therefore, it would seem desirable to devise a reliable, valid, objective serve test. Following the development of such a test, further study on its use, together with the Dyer, with the Miller, or with a combination of the Dyer and Miller tests, would prove to be of value.

The Professional Status of Head Coaches of Athletics in Colleges and Universities

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AMERICAN COLLEGE coaches have been placed in a unique position by the very nature of the field in which they operate. Their efforts are continually undergoing appraisal by students, alumni, community groups, and the press. Few individuals in higher education receive as much publicized acclaim or criticism as do the instructors of college competitive sports in the United States. Although the field of athletics is probably the most publicized of any of our educationally sponsored activities, there is little research information to be found on the professional characteristics of the individuals directly responsible for teaching and leadership in this area. Documentary material available concerning their professional status in institutions of higher education is meagre.

Purpose

It was the purpose of this investigation to determine as accurately as possible the professional status of head coaches of athletics in colleges and universities.[1] The study was divided into four major areas dealing with academic background and experience, conditions of employment, duties and responsibilities, and salaries.

Limitations

First, the problem concerned itself only with male *head coaches* actively engaged in the instruction of college varsity teams. Second, the 14 sports covered are those which are endorsed by the National Collegiate Athletic Association, and over which this organization exercises certain controls.[2] Third, coaches of four year colleges listed in the NCAA Yearbook of 1949 were surveyed with minor exceptions. The survey included coaches of 264 member institutions, and at least one response was received from every college represented. Finally, research was limited to the investigation of the professional factors related to the problem.

Procedures

A 24-item printed questionnaire was developed and presented to respondents in a four page folder, which included a letter of transmittal on the front leaf.

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[1] Richard C. Havel, *The Professional Status of Head Coaches of Athletics in Colleges and Universities*, Unpublished Doctor's dissertation. New York: Teachers College, Columbia University, Dec. 1951, p. 178.

[2] The sports used were: baseball, basketball, boxing, fencing, football, golf, gymnastics, ice hockey, lacrosse, soccer, swimming, tennis, track, and wrestling.

The types of questions employed required the one word (fill in) answer, the check list answer, the yes and no answer, and the columnar (fill in) answer. Coaches were assured that the information they provided would be kept confidential, and that names of individuals or names of institutions would not be divulged. Sixteen hundred seventy-two questionnaires were mailed in the initial wave on January 15, 1951. On February 15, 1951, a follow-up of 525 questionnaires was sent to those persons who had not responded.

Findings are based on an actual return of 1,093 questionnaires, representing a 65% response. A thorough sampling of coaches throughout the United States is included, with all geographical areas and all sports well represented in relation to their popularity in the intercollegiate program. The percentage returns according to geographical location were: 68% in New England; 61% in the Middle Atlantic region; 59% in the South; 71% in the Middle West; 63% in the Central United States; 58% in the Southwest; 73% in the Rocky Mountain area; and 75% in the Far West.

Information received on each item in the questionnaire was tabulated according to the sport coached, and the results were computed in percentage form. A complete picture of the status of the coaches of the different sports in relation to each question is provided. Questions in the section on *academic background and experience* covered age, age at which first head coaching position on a college level was obtained, degrees earned, years of coaching experience, varsity letters won in college, and professional sports played. Items under *conditions of employment* dealt with length of employment at present institution, tenure, contracts, retirement provisions, faculty rank, and opinion of faculty status for coaching personnel. Under *duties and responsibilities* coaches were asked the amount of time they devoted to actual coaching on and off the field; the number of assistants they had; and other duties for which they were responsible and the time spent in performing these additional assignments. Inquiries on *salaries* covered total annual salary received from the college, yearly salary increments, extra remuneration for coaching, and additional types of employment and additional income earned.

Questionnaires mailed to coaches were distributed according to sport, and the percentage of returns is presented in Table 1.

Summary of Findings

Academic and Experience Backgrounds of College Coaches. The academic achievements of the men responsible for coaching athletic teams in American colleges are widely diversified. Ninety-five percent have earned Bachelor's degrees, 55% hold Master's degrees, and 4% hold Doctor's degrees. Five percent of the men actively engaged in the intercollegiate field have not received any academic degrees. A little better than half of the coaches (52%) have had specialized undergraduate preparation in physical education. Of those who have done graduate work, the ratio is much higher with 80.5% of the men specializing in physical education on the Master's level. The 51 coaches (4%) reporting Doctor's degrees had done advanced study in many different fields, too numerous to include here.

TABLE 1

Distribution of Respondents According to Sport

Sport	No. Coaches Surveyed	No. Returns Received	Percentage Return
Gymnastics	28	25	89
Wrestling	122	91	75
Football	230	169	73
Lacrosse	37	27	73
Baseball	231	165	71
Basketball	258	178	69
Soccer	66	45	68
Track	245	162	66
Fencing	51	33	65
Swimming	157	101	64
Tennis	218	131	60
Boxing	42	23	55
Gulf	193	107	55
Hockey	37	17	46
Totals[1]	1915	1274	67

[1] Totals include coaches who may have been directly responsible for more than one sport but yet received only one questionnaire. In these cases responses were tabulated for each sport in which the individual was head coach, accounting for the increased totals noted above.

The largest number of college coaches have been in the field of intercollegiate athletics as assistant or head coaches for ten years or less. Time spent coaching on the college plane varies considerably with the sport coached. Men with the longest experience backgrounds in college work are found in track, where 48 percent have been active in the field from 16 to over 30 years. Next in rank order of length of service come instructors of boxing, baseball, football, basketball, and soccer, where at least 25 percent have coached 16 or more years. Almost half the men in college positions (47%) had previous experience on the secondary school level, most of them for a comparatively short number of years. Twenty-two percent of all respondents served in some coaching capacity in the armed forces in World War II. A small group also reported having coached professional teams or served as professionals in the individual sports of golf, tennis, and fencing. Coaching experience, other than that on the college level, may function to advantage in individual cases. Probably the most convincing qualification one can offer for advancement in this highly competitive field is the establishment of a reputation as a winning college coach.

A background of participation in college athletics serves as an initial foundation upon which men in this profession build. Very few individuals are presently coaching a sport in which they did not excel, either as college or professional performers. Only one out of every ten men in the field has not participated in college athletics, and over 60 percent won major letters in more than one sport. Varsity participation is to be looked upon as a vital qualification for all potential leaders of college athletic activities. Positions gained at the outset of one's career in this area are greatly dependent upon a past record of intercollegiate sports activity. The sports in which varsity letters were earned by college coaches as undergraduates are shown in Table 2.

TABLE 2

Sports in Which Varsity Letters Were Earned by College Coaches

Coaches of	Varsity Letters Won														
	No letters	Base-ball	Basket-ball	Boxing	Fencing	Foot-ball	Golf	Gym-nastics	Hockey	La-crosse	Soccer	Swim-ming	Tennis	Track	Wrest-ling
Baseball	4%	**81%**	55%	.5%	—	68%	—	—	2%	—	.5%	2%	.5%	13%	2%
Basketball	6	48	**85**	—	—	58	.5	—	—	—	.5	—	6	22	.5
Boxing	35	13	9	**48**	—	35	—	—	—	4	—	4	—	13	9
Fencing	21	3	—	—	**78**	9	—	—	—	—	3	—	—	3	3
Football	1	41	43	1	—	**97**	2	.5	2	.1	—	2	1	27	5
Golf	18	33	35	1	1	48	**22**	—	2	2	1	2	6	13	3
Gymnastics	8	16	8	4	—	16	—	**76**	—	—	8	4	8	24	—
Hockey	18	47	12	—	—	53	5	—	**65**	—	18	—	5	—	—
Lacrosse	7	11	30	7	—	56	—	4	—	**70**	19	4	—	15	4
Soccer	16	16	20	—	—	16	—	9	4	11	**44**	4	9	16	11
Swimming	13	6	2	1	—	31	2	.5	1	2	3	**40**	1	14	1
Tennis	21	11	33	1	—	24	2	2	2	—	2	5	**47**	16	4
Track	9	14	31	1	—	57	.5	2	2	—	2	2	1	**75**	2
Wrestling	7	13	10	7	—	52	—	3	—	3	3	3	—	27	**68**
Totals	10%	32%	38%	2%	2%	53%	3%	3%	2%	3%	4%	5%	7%	25%	8%

TABLE 3

Faculty Ranks Held by College Coaches

Coaches of	Prof.	Assoc. Prof.	Asst. Prof.	Instr.	No Rank	Other
Baseball	13%	15%	19%	24%	24%	5%
Basketball	12	18	27	16	22	5
Boxing	13	17	18	26	13	13
Fencing	15	3	21	15	46	—
Football	20	20	17	14	23	4
Golf	12	19	22	22	18	7
Gymnastics	4	12	36	36	4	8
Hockey	—	12	12	23	53	—
Lacrosse	11	7	30	22	50	—
Soccer	7	16	29	20	22	6
Swimming	10	11	33	24	15	7
Tennis	12	9	35	22	18	4
Track	17	24	21	20	14	4
Wrestling	4	15	28	27	22	4
Totals	13%	16%	25%	21%	20%	5%

Conditions of Employment in College Coaching. Conditions of employment vary considerably, being greatly dependent upon the type of educational institution at which one is located and the sport coached. Practically one-third of the men teaching athletics in colleges throughout the country have been located in their present positions for from one to three years. Twenty-seven percent have served in the same college for from four to six years. This means that just about six out of every ten persons in the coaching population have been employed by the same educational organization for less than seven years. All indications point toward a comparatively short tenure of service for many of the coaches at any one institution. Age ranges for coaches also show that many leave active coaching after the age of 50.

Over one-fourth of the men coaching college teams in the United States are given no assurance of retention either by tenure or written contract. Thirty-seven percent of those persons surveyed enjoy tenure privileges. (Tenure, for purposes of this study, was interpreted to mean a system of college employment in which the teacher or other employee, having served a probationary period of a specified number of years, retains his position by rules of the college.)[3] Contracts given to coaching personnel are primarily of the short term variety, with one year agreements being the most common. Thirty-five percent of the respondents reported having some type of written contract with the institution which employs them.

Retirement plan participation is made available to a large majority of the instructors of intercollegiate athletics, the provisions varying with the institution. Professorial rank is held by a little better than 50 percent of the coaches studied, with one out of four holding assistant professorships. Heavy concentra-

[3] Adapted definition from Carter V. Good, *Dictionary of Education*, New York: McGraw-Hill Company, Inc., 1945.

tions of individuals were also found in the instructor and "no rank" categories. A breakdown of the faculty ranks held by head coaches is presented in Table 3. Most coaches indicated that they were desirous of obtaining faculty status with respect to such privileges as faculty rank, tenure, retirement, and sabbatical leave. Publicly supported colleges seem to be more inclined to tender faculty membership to coaching personnel than are any of the other types of educational institutions.

Time Spent in Coaching. The hours devoted by college coaches to actual varsity instruction on the field or in the gymnasium vary slightly with the activity. A large majority spend between 10 and 24 hours a week in practice sessions and intercollegiate contests. However, all of coaching is not represented alone by what takes place on the field or in the gymnasium. Great differences exist in the time taken up in the various sports in the development of plans and tactics for forthcoming competition. Forty-one percent of the athletic coaches devote less than ten hours weekly to preparation and planning. Those individuals engaged in teaching football are ahead of all others by far in this respect. Over 50 percent of the football group spend 30 or more hours a week in planning. A sizeable percentage of coaches of hockey (30%) and basketball (28%) reported over 20 hours a week in preparation "off the field."

Additional Responsibilities. In addition to their coaching assignments, many college coaches have one or more duties for which they are responsible. The most frequent duty with which they are concerned is the teaching of physical education activities (51%). This is followed by teaching professional prepara-

TABLE 4

Additional Duties Performed by College Coaches

Coaches of	Types of Duties Performed								
	No Other Duties	Teaching Physical Education Activities	Teaching Academic Subjects	Professional Preparation Courses in Physical Ed.	Administration in Physical Education	Administration in Athletics	Administration in Other Departments	Coaching Other Sports as Assistant	Other Duties
Baseball	8%	54%	3%	29%	8%	20%	1%	50%	23%
Basketball	8	53	—	38	8	19	2	41	20
Boxing	17	61	—	22	17	13	4	13	17
Fencing	39	45	18	9	3	3	3	6	18
Football	14	37	—	38	5	33	2	8	20
Golf	11	47	15	19	7	11	13	24	24
Gymnastics	—	68	8	52	16	—	4	16	40
Hockey	12	47	6	6	12	12	6	47	41
Lacrosse	7	59	4	4	4	4	7	44	15
Soccer	9	58	13	20	13	2	2	24	24
Swimming	9	65	8	22	8	2	4	19	30
Tennis	11	46	27	20	8	2	11	13	28
Track	7	46	3	45	15	14	2	28	28
Wrestling	13	65	4	29	4	4	2	37	23
Totals	11%	51%	7%	30%	9%	14%	4%	27%	24%

tion courses in physical education (30%) and coaching other sports as an assistant (27%). Many reported other duties of various types which are too numerous to be defined individually (24%). Some of the respondents, particularly in football, have no additional responsibilities other than those directly related to their sport (11%). Less numerous responsibilities include administration in athletics (14%), administration in physical education (9%), the teaching of academic subjects (7%), and administration in other college departments.

Many athletic coaches perform one or more of the major duties outlined in Table 4. Eighty-nine percent of the instructors of intercollegiate athletics have at least one other duty for which they are responsible. More than one-half of the group studied devote time to two or more of the areas which are mentioned above. Approximately one out of every five coaches is concerned with performing three or more of the duties listed, in addition to coaching a varsity team.

Over 15 percent of the men in the coaching field are head coaches of more than one sport. Some direct two varsity teams, and a very small minority are responsible for three activities. Sport combinations are many, and are found in all types of institutions, with the small colleges leading all others in the number of men who are two and three sport coaches.

Salaries Earned by College Coaches. Seventy-five percent of all the coaches surveyed receive less than $6,000 a year. Of this group one out of every four earns less than $4,000, some of these being part-time employees. Opportunities for higher salaries are available for a limited few who are specialists in those activities which promise financial returns to the institution or which enjoy a traditional place of importance in the program of athletics. The salaries of the coaches of the different sports are indicated in percentage form in Table 5.

All the evidence points toward several factors which determine and influence the size of salaries. The first and most important of these is *sport specialty.* Certain activities usually demand higher salaries than do others; without question football is the most promising area financially for college coaches, followed at a distance by basketball. Second, *additional responsibilities* other than coaching may condition to a large extent the salary earned. Coaches who are also engaged administratively in departments of physical education and athletics and in teacher preparation work in physical education usually receive higher salaries than do those who perform some of the other duties already enumerated. Third, the *type of institution* at which one is employed often has some conditioning effects on salary. Salaries over $6,000 are most frequently in large private institutions, state colleges and universities, municipal colleges, and private institutions with enrollments of over 3,500 students. Fourth, *age* operates as an influential factor in some cases. Coaches under 30 earn lower salaries than do those over this age, and most of the higher salaries are earned by men over forty. Fifth, in a limited sense *geographical location* affects the size of salaries paid coaches of the various sports studied. The Southwestern and New England areas have the largest percentage of coaches earning over $6,000 a year. The Middle Atlantic, Southern, and New England colleges have the highest percentages of coaches receiving less than $4,000 annually. Sixth, and probably least important as far as salaries over $8,000 are concerned is *academic achievement* in the form of earned college degrees. Men with doctor's degrees

TABLE 5

Salaries Earned by Coaches of College Sports

Coaches of	Salaries in Two-Thousand Dollar Ranges											
	Under 2	2-4	4-6	6-8	8-10	10-12	12-14	14-16	16-18	18-Over	Volunteer & Student Coaches	No Ans.
Baseball	1%	23%	52%	16%	5%	.5%	—	—	—	—	.5%	2%
Basketball	1	18	47	22	9	1	—	—	—	—	—	2
Boxing	4.5	17	56.5	13	4.5	—	—	—	—	—	4.5	—
Fencing	15	24	33.5	3	—	—	—	—	—	—	21.5	3
Football	—	7	40	19	13	9	6.5	2	1	.5	—	2
Golf	6	22	43	16	2	—	—	—	—	—	5.5	5.5
Gymnastics	—	36	56	8	—	—	—	—	—	—	—	—
Hockey	—	41	35	24	—	—	—	—	—	—	—	—
Lacrosse	4	37	41	18	—	—	—	—	—	—	—	—
Soccer	9	27	47	15	—	—	—	—	—	—	2	—
Swimming	6	34.5	44.5	9	1	—	1	—	—	—	1	3
Tennis	8.5	28	50.5	9	—	—	—	—	—	—	2	2
Track	2.5	22	59	13	3	—	—	—	—	—	—	.5
Wrestling	10	31	52	5	—	—	—	—	—	—	2	—
Totals	4%	23%	48%	14%	4%	1.5%	1%	.2%	.2%	.1%	2%	2%

do have better than double the percentage found for any other group in the $6,000 to $8,000 salary class. However, the number of salaries over $8,000 are similarly distributed for all degree groups.

The majority of college coaches throughout the United States do not receive annual increments in salary. Those who are in positions where they are granted automatic yearly raises are usually employed in municipal institutions or in state teachers colleges. The most frequent size of a regular salary increment is between $100 and $199.

About one-half of the head coaches of college teams supplement their incomes by engaging in some form of additional employment. Fifteen percent of the entire group responding to the questionnaire reported receiving extra money from a variety of sources too numerous to categorize. Summer camp work, public speaking engagements, and coaching clinics are the most popular areas in which athletic leaders are active. For the majority of individuals who participate in outside employment, the approximate annual earnings range between $100 and $1,999. A very small number, most of them coaches of national prominence, command higher additional incomes.

Conclusions

It becomes evident in reviewing the findings of this study that wide differences exist in the professional status of head coaches of athletics in the colleges and universities of the United States. All areas investigated reveal a variety of conditions prevailing for the instructors of the 14 sports included in the survey. There are indications that the coaches of those sports which are by tradition firmly entrenched in the intercollegiate program, or which return financial profit enjoy a better status than do those in the lesser emphasized activities. Despite the broad ranges which are found in the professional standing of college coaches, certain conclusions can be drawn from the data compiled.

1. A small majority of the coaches have had formal undergraduate preparation in physical education, with a much higher ratio of specialization in this area being found for those who have completed the requirements for the master's degree.

2. Better than one-half of the men in intercollegiate athletics have been coaching for ten years or less. The longest experience backgrounds in college work were reported by coaches of track, followed in rank order of length of service by instructors of boxing, baseball, football, basketball, and soccer.

3. A high school coaching background may prove advantageous but is not to be considered an essential step to be experienced prior to obtaining a college coaching position, since fewer than 50% of the respondents had this type of experience.

4. A successful record of undergraduate participation in intercollegiate sports is to be considered a most vital and necessary qualification for men in this field, especially in the activity one is to coach.

5. Conditions of employment in college coaching vary greatly and are largely dependent upon the type of institution at which one is employed and the sport coached.

6. Tenure privileges are extended to some coaches, but the largest number are employed on a year to year basis.

7. Athletic coaches are in favor of obtaining faculty status, and over 50 percent of those coaching presently hold assistant professorships or better.

8. The time devoted by coaches to instruction on the field in season differs little in the sports studied, but the ranges of time spent in preparation off the field are broadly varied.

9. Most of the men coaching intercollegiate teams are responsible for performing duties in addition to their coaching assignment, the most frequent being the teaching of physical education activities and teaching professional preparation courses in physical education.

10. For the large majority, the salaries of college coaches are modest, 75 percent of them being under $6,000, with the most important conditioning factor being the sport specialty.

Some Notes on a College Proficiency Test in Hygiene

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AN ANALYTICAL study was made of the results of a Hygiene Proficiency test given in September 1951 to an entering group of Freshmen at the University of Illinois.[1] Proficiency tests are given each term in many departments and, on successful completion thereof, some departments allow college credit equivalent in amount to that ordinarily given in the course for which the proficiency test is written, while other departments merely grant permission to pursue more advanced work in the particular department. Passing a Freshman Hygiene proficiency test allows two semester hours of college credit, and excuses the student from taking the regular required course in Hygiene.

The examination to be discussed in this paper was designed to cover information which one might expect an entering college Freshman to have acquired in the field of healthful living, and included questions on both factual knowledge and on the knowledge of currently accepted practices and attitudes in the various phases of Hygiene.

The questions were of the multiple-choice (five alternative) variety, and were similar in type and content to those used in the ordinary standard Health Knowledge tests. There was a fair sampling within six large areas of health: Public Health and Consumer Health, General Bodily Hygiene, Mental Health, Personal Health Problems, Reproduction and Sex and Heredity, and finally Nutrition and Diet. Within these larger areas, questions were distributed among the topics usually covered in college-level health courses.

One question representing each of the above groups follows;

1. The reliability of a medicinal product is unquestioned because;
   (a) Radio commercials praise it
   (b) Druggists recommend it
   (c) Newspapers carry full-page ads describing it
   (d) Department stores sell it
   (e) Reliable physicians prescribe it
2. One of the following statements is *not* applicable to the subject of good skin or scalp hygiene;
   (a) Bathing daily is recommended for most normal individuals
   (b) It is advisable to use perfumed soaps and various creams and oils to "tone up" facial skin and muscles
   (c) Clothing should be porous to some degree and fit loosely enough to permit some air circulation close to the skin
   (d) Many cases of adolescent acne clear up spontaneously
   (e) Walking barefooted in shower rooms or hotel bathrooms may be a means of contracting "athlete's foot"

[1] Since questions included in this test are repeatedly used in proficiency tests with students they cannot be published in their entirety at this time.

3. A student with normal intelligence, good morals, good family background, excellent health, and a good scholastic record in high school fails to make his grades the first term. A recommendation should be made;
   (a) For his dismissal from college
   (b) For a disciplinary conference with his dean
   (c) For a simplified program of required subjects outlined by his advisor without the consent of this student
   (d) For a disciplinary conference with his advisor and parents
   (e) For a visit to a psychological counselor
4. Which one of the following organs belongs only to the female sex?
   (a) Mammary glands
   (b) Vagina
   (c) Scrotum
   (d) Seminal vesicle
   (e) Testis
5. The term "calories" applies to which of the statements below?
   (a) A measure of energy produced by a known amount of food in a given time
   (b) Weight of a given amount of food
   (c) Name of a carbohydrate group of foods
   (d) Substances found in carbohydrates
   (e) Chemicals added to foods to bring out their flavor
6. The adult rate of heart beat is normally;
   (a) 30–40 per minute
   (b) 100–110 per minute
   (c) 60–80 per second
   (d) 60–80 per minute
   (e) 15–20 per second

Procedure

A total of 70 questions was IBM-scored for over 1,100 students, and the first 500 of these, in alphabetical order, were later hand-checked for further study. It seemed desirable to discover in which fields of health teaching the incoming students had acquired the least proficiency as well as in which fields these students had demonstrated the greatest understanding. Such findings could then provide a guide for the later placing of emphasis in the areas which needed most strengthening in the teaching program.

Students taking the examination were practically all members of the Freshman class, men and women from 17 to 19 years of age, representing an unselected volunteer group from large and small urban and rural high schools chiefly from within the State of Illinois. Their professed interest fields also varied, as shown in Table 1.

Table 1 lists the number of students according to their professed fields of interest (Columns II to IX) and the total number of questions missed or refused by students representing each field (Column I). A passing grade of 75% permitted missing 17 of the total of 70 questions (Column I, lines A through D). A total of 338 of the grand total of 1,157 students, or approximately 30%, attained this rating (Column X, lines A through D).

Table 2 shows the total number and percentage of students within each interest field who attained a passing grade.

TABLE 1

The Number of Students and the Number of Questions Missed in Each Interest Group

Columns I		II	III	IV	V	VI	VII	VIII	IX	X
No. of questions missed		Interest fields and number of students in each								
		Agric.	Comm.	Educ.	Eng.	FAA	LAS	P.E.	Uncl.	Total
A	0–5	1	1	—	—	—	11	—	1	14
B	6–10	6	5	1	15	7	44	—	11	89
C	11–15	27	13	3	19	8	72	2	18	162
D	16–17	10	7	3	12	4	29	1	7	73
E	18–20	21	21	3	17	15	51	4	12	144
F	21–25	52	38	5	37	18	85	5	18	258
G	26–30	39	24	2	32	18	64	4	25	208
H	31–35	30	16	6	21	7	25	2	11	118
I	36–40	11	17	2	9	4	16	4	4	67
J	41–45	2	4	—	4	—	4	1	2	17
K	46–50	2	1	—	—	—	2	2	—	7
L	Totals	201	147	25	166	81	403	25	109	1157

TABLE 2

Number and Percent of Students with Passing Grades (Missing or Refusing No More than 17 Questions)

Interest field	No. of students	No. passed	% passed
Agriculture	201	44	21.8
Commerce	147	26	17.7
Education	25	7	28.0
Engineering	166	46	27.7
Fine and applied arts	81	19	23.4
Liberal arts and sciences	403	156	38.7
Physical education	25	3	12.0
Unclassified	109	37	34.0
Total	1157	388	29.2

Excepting the fields of Education and Physical Education, where the numbers were too small to be significant, and the Unclassified group which consists of a mixture of students who had neglected to mention their choice of field, or had not yet chosen one, it will be seen from a study of Table 2 that students preparing to enter Liberal Arts fields in college seemed better prepared in the various phases of health knowledge than those preparing to enter other fields. For the most part, these students had had more preparation in biological sciences, which gave them some basic information for that part of the test dealing with certain aspects of personal health problems as these are related to form and function of the human body.

Finally, Table 3 shows the grouping of questions around six areas of health teaching, based on subject matter content (Column III). Column I shows the number of questions in each area arranged in their increasing order of difficulty, as evidenced by the average number of times each question was missed or refused by 500 students (Column II). For example, there were 20 questions on

Public Health and Consumer Health and, among the 500 students, a total number of misses or refusals of 2,287 for the 20 questions netted an arithmetical average of 114 times per question. The greatest difficulty was encountered in the group of 16 questions on body structure and function (listed as Personal Health Problems) with an average of 201 misses per question, while the field of Nutrition, with 11 questions and an average of 191 misses per question, ran a close second in point of difficulty.

TABLE 3

Average Number of Misses or Refusals for Questions in Each Area

Col. I	Col. II	Col. III
Number of questions in each area	"Average" number of times missed	Area of health instruction
20	114	Public and consumer health
7	143	General bodily hygiene
4	150	Mental health
12	183	Reproduction, sex, heredity
11	191	Nutrition and diet
16	201	Personal health problems

NOTE: Values are calculated for 500 student examinations of 70 questions each.

Among the 70 questions, 57 were based on factual knowledge and each was missed or refused an average of 165 times, whereas the remaining 13 questions, based on a knowledge and understanding of accepted health practices and health attitudes, were missed or refused on an average of only 131 times each.

Discussion

On the basis of the above analysis of a group of 70 questions written by more than 1,100 college Freshmen, it appears that only one student in every three presenting himself for this test had the background or knowledge to pass with a grade of 75 per cent. Ninety-one students, or one in every 12, missed more than one-half of the total questions (Table 1, Col. X, lines I–K). This would seem to indicate that there is need for more study to discover where the lack of preparation at lower grade or high school levels should be supplemented, and where the greater emphasis should be placed in college health teaching.

Conclusions

While it is obvious that further study along the above lines is needed, there is some evidence that more rigorous programs of health teaching are indicated at all levels of training if our young adults are to be equipped with information on the basis of which they may develop attitudes and habits concerning healthful personal and community living which will help protect them and their families, and enable them to enjoy life to its fullest capacity.

Influence of Emotional Tension on Speed of Reaction and Movement[1]

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THE EFFECT OF tension and emotion on physical performance has not been studied to any great extent. The writer is aware of an Olympic athlete who deliberately made himself nervous prior to athletic competition on the supposition that it made him react faster, and knows of other athletes who follow this procedure.

Reviews have been published by Davis (6) and Courts (3), dealing with tension and mental performance; other studies that investigated physical response have been concerned only with whether tension facilitates or inhibits performance. Responses which have shown facilitation under tension are pursuit learning (4), reaction time (9), tapping (2), knee-jerk, etc. Some performances, such as throwing tennis balls at a target (14) and postural steadiness (15) have been reported as being inhibited under tension. Bills (1) called attention to two types of tension; one type is due to emotional upset and is inhibitive of performance, and the other is due to effort and is facilitative.

An interesting experiment by Jackson (10) on the effect of emotion on muscular co-ordination was concerned with the differences between beginners and experts in an aerial gymnastics group. Their performances were judged by graphing cinema records of their movements in the air. Emotional feelings were evaluated from subjective questionnaires. The beginners were noted to exhibit a lack of co-ordination, and all individuals when in a fear situation performed like beginners. The ability to co-ordinate in the latter instance was said to decline noticeably.

Warren Johnson (11) made a study of emotion in two types of athletic sports contests. The subjects (5 wrestlers, 15 football players) were given subjective questionnaires and heart rate, blood pressure and blood sugar tests, in order to assess the pre-contest emotional reactions several days, a few hours, or immediately before the contests. Strong pre-contest emotion was not prominent in the football players, but was marked in the wrestlers.

These experiments show the importance of emotional tension on large-muscle activities, but lack evaluation of the effect on performance of various degrees of emotional tension. The participants in individual sports are perhaps more tense than in the team sports, but would the individuals in the latter be faster or slower or remain the same if their emotional tension was increased? What, if any, are the optimal limits of such tension?

[1] From the Research Laboratories of the Department of Physical Education, University of California, Berkeley. The writer is indebted to Dr. Franklin M. Henry for invaluable assistance and guidance throughout this study.

Questions such as these are of vital concern in physical education, and it was the aim of this experiment to answer some of these questions, or at least to further the progress towards their solution.

Changes in bodily states due to emotion and tension are too well known to require discussion here. Reviews have been made by Johnson (12) and Woodworth (16, *pp. 242–230*), among others.

A major problem in the study of tension and emotion is the difficulty in the production of the desired situations in the laboratory.

Problems Investigated

The primary purpose of the present study is to test the hypothesis that emotional tension causes changes in reaction time and/or speed of movement. It is proposed to observe whether the most improved performances have any relationship to the degree of emotional tension of the individual.

In addition, there are several subsidiary problems that are investigated concurrently:

(a) the relationship between personal evaluations of emotional condition and the degree of emotional tension as exhibited by the physiological correlates of emotion, such as heart rate, blood pressure, breathing, and skin resistance.

(b) the relationship between the subject's evaluation of his emotional tension and the experimenter's evaluation of the subject's emotional tension.

(c) the "information" hypothesis recently advanced by Henry (9) to explain the improvement in reaction and movement times when a motivating stimulus is given the subjects when they make slow responses.

Methodology

Reaction and Movement Times. The apparatus used to measure the reaction and movement times was the same as that used by Henry (9) except for two alterations. Two tennis balls were used, as explained later, in order to lengthen the movement time. The electric shock was increased to a range of 7 to 16 milliamperes in order to make the subjects emotionally disturbed. This was accomplished by shorting out the neon light in the shock circuit.

S (the subject) sat on a stool facing the apparatus (see Figure 1) and at a comfortable distance from it. The middle finger of the right hand rested on the hand reaction key. With the onset of a bright stimulus light, he lifted his hand as quickly as possible from the key and moved it upwards some six inches to grab the first tennis ball, back down to touch a switch button on the baseboard, and then up and across to grasp the second ball which disconnected the circuit. Although the baseboard button was not connected electrically, *S* believed that it was, and careful scrutiny insured that this movement was always made.

There were two chronoscopes. Both started when *E* (the experimenter) flashed the stimulus light. The first recorded the time taken to leave the hand reaction key (*RT*) and the second, which stopped with the seizure of the last ball, measured total time (*TT*). The difference between these two readings gave the movement time (*MT*).

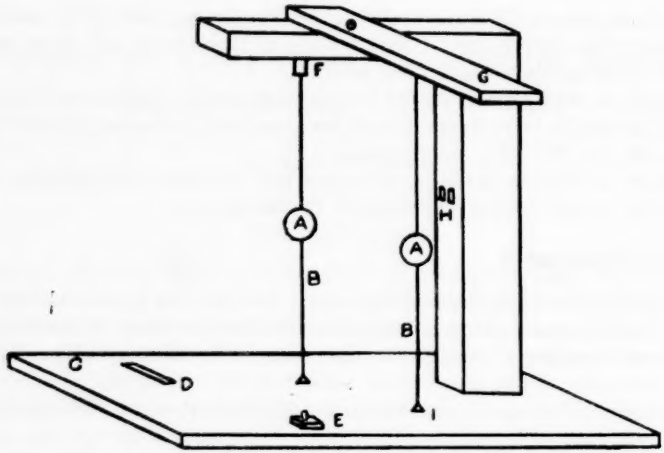

FIG. 1. Speed of Movement Apparatus. A—tennis ball; B—48 lb. nylon cord; C—base board; D—reaction key; E—push button; F—friction contacts; G—side arm; H—signal lights; I—cord holder.

Skin Resistance. A Wheatstone bridge of the substitution type, similar to that employed by Darrow (5), was used to measure the electrical resistance of the skin. Electrodes attached to *S* were inserted in the adjustable 400,000 ohm leg of the bridge, and the resistance of this leg was decreased until all resistance legs of the bridge were in balance, giving a galvanometer reading of zero. If the subject's skin resistance changed, the potentials were thrown out of balance and a deflection of the galvanometer resulted. (During or following emotion-arousing situations there is usually a lowering of electrical resistance between the two electrodes on the skin due to increased activity of the sweat glands in the palm of the hand.) The current through the subject's electrodes was very small, even though a 12-volt battery was used, owing to the fact that the instrument was a high resistance bridge. One virtue of this substitution-type bridge is that the current is the same for all subjects regardless of their individual resistance.

Prior to the experiment, kaolin (a purified clay) was mixed with 6-per-cent zinc sulphate solution until the resultant mixture was putty-like in appearance. The mixture was moulded into the hollow section of the electrode using care to press out all air bubbles. The electrodes were of zinc, each being one inch in diameter, sealed into a holder made of bakelite, with a rim that projected $\frac{5}{32}$ inch beyond the edge to provide a cup to hold the electrode paste. The electrode paste prevented direct metal-contact with the skin, in order to reduce polarization. The area of the arm and hand to which the electrodes were secured was cleansed with saline solution beforehand.

The active electrode was placed on the palm of the hand; the indifferent electrode on the inside of the forearm, approximately three inches above the wrist. They were held in place by means of an elastic strap, so fastened that electrode

movement was reduced to a minimum, but caution was exercised that the circulation was not impaired in any manner. As movement of this arm might change the electric resistance of the skin, *S* was told to relax his left arm and to maintain it in a constant position. The left hand rested on the baseboard of the apparatus with the palm facing upwards.

The electrodes were cleansed immediately after use with distilled water. The kaolin-zinc sulphate paste was removed by combined usage of distilled water and soft tissue paper, followed by polishing as necessary with a one-inch disc of sandpaper glued to the end of a stick. It is necessary to observe these precautions in order to secure consistent results.

Pneumograph. A deeply corrugated rubber tube about 1½ inches in diameter was placed around the chest and fastened at the back. A smaller tube led to a metal tambour which operated a recording pen on a chronograph, not visible to the subject.

Circulation Measurements. Standard equipment was used to measure blood pressure by the auscultation technique. Because of the presence of the shock and skin resistance electrodes, the cuff was used on the right arm of *S*. Both systolic and diastolic pressures were recorded. The pulse was counted by the usual method.

Procedure

Table 1 simplifies the explanation of the experimental procedure, which required a total time of 50 minutes for each *S*.

TABLE 1
Experimental Procedure

1. Pre-test	2. Test period	3. Post-test
1. Subject seated on stool facing the apparatus	A.1) 5 *RT*, *MT* and *TT* trials followed by skin resistance, blood pressure, pulse rate (30 seconds) and breathing rate (1 minute)	1. Breathing rate—5 minutes
2. Zero adjusted on skin resistance apparatus	2) Repeated as in (1)	2. Skin resistance every minute
3. Electrodes placed on palm and forearm	3) Repeated as in (1)	3. Pulse rate 30 seconds every minute
4. Pneumograph adjusted	B.1) Instructions for shock—shock-prevention series	4. Blood pressure at conclusion of experiment
5. Explanation of skin resistance and pneumograph	2) 5 trials—same physiological measures as in (1)	5. *E* evaluates tension of the individual
6. Pulse rate taken—30 seconds	3) 5 trials. Same physiological measures as in (1)	6. *S* evaluates tension
7. Breathing rate recorded—4 minutes	C.1) Instructions re shock—shock-imposed series	
8. Blood pressure	2) 5 trials—same physiological measures as in (1)	
9. Skin resistance	3) 5 trials—same physiological measures as in (1)	
10. Instructions for *RT* apparatus		

Subjects. Ten *Ss* were tested in a preliminary experiment, to familiarize the experimenter with the apparatus and to standardize the procedure. Following this 50 *Ss* were tested. All were volunteers and all athletes (males), who were or

had been participating in major and minor sports including football, rugby, baseball, swimming, water polo, boxing, wrestling, crew, basketball, and gymnastics. Not all were university letter winners, though 65 per cent actually were; however they were all considered proficient in their respective sports.

Experimental Design. All subjects participated in the three series of trials, i.e. the without-shock series, the shock-prevention series and the shock-imposed series. The number of trials in each series and the order of the series is shown in Table 1. All 50 *Ss* performed the "without-shock" series first, then 25 *Ss* performed the "shock-prevention" series next and 25 performed the "shock-imposed" series instead. (The distinction between these series will be explained in a later section.) This selection was made at random and was decided upon before *S* entered the room and without observing the listing of names. The purpose of this balanced order of testing was to minimize the possibility of the results of a particular series being due to learning or to a practice effect. The age range was from 17 to 30 years, average age being 21.2 years. No *S* had been tested beforehand on the experimental apparatus.

TEST INSTRUCTIONS

Series Without Shock. *S* was told that the Wheatstone bridge was an instrument used to measure skin resistance and that *E* wished to see the changes resulting from movement. He was not informed that it had anything to do with emotion. He was also informed that it was not possible to receive a shock from the apparatus, and that the pneumograph measured breathing rate. It was emphasized that he should not talk when any of the measures were being taken as it would invalidate the results. This was sometimes difficult to enforce, as some *Ss* were emotionally upset and expressed their emotions verbally. *S* was informed that the electrodes on his upper arm (i.e., the shock apparatus, though never named as such) required some explanation and would not be in use until the latter part of the test. It was stated that this apparatus would be fully explained prior to use. The co-ordination apparatus was explained and demonstrated, with emphasis on the necessity to move as fast as possible in each response. It was also mentioned that the period between the ready signal and the signal light would be irregular. After 15 responses (with physiological measures, as explained earlier), *S* was asked if he had prior knowledge that he would be shocked in the experiment. No *S* admitted that he had heard he would receive a shock.

Series With Shock. While half of the *Ss* performed the "shock-imposed" series first, as stated earlier, it will simplify the explanation to assume temporarily that all *Ss* engaged in the "shock-prevention" series first. *S* was now informed that the electrodes on the upper arm were for the purpose of giving him an electric shock. It was explained that the shock timer had been set to deliver a shock any time his response was slower than the average of his previous responses. This meant that if he performed better than previously he would disconnect the timing apparatus before the shock appeared and hence not be shocked. If his speed was just average or poorer, the shock would begin and last until his response was completed. It was repeatedly emphasized that the movement had to be completed for the shock to disappear. The shock would vary

but generally it would be extremely heavy. It would not injure or burn him, but nevertheless would be very severe and might be increased at any time. As *S* speeded up his reactions, the average time at which the shock was set to commence was accordingly lowered. He therefore had to maintain any improvements in order to escape the shock.

After ten tests, the "shock-imposed" series was introduced. *S* was informed that the shock timer was now set at an impossible score—in other words, shock would occur no matter how fast he reacted, although as before it would last only until the completion of the response. It would come at different times, sometimes at the start of the movement, sometimes in the middle, sometimes at the finish, and in some cases not at all; he had no way of knowing. A set pattern of shocks was given in this series, though this was varied occasionally when a subject became too upset with the heaviest shock.

A few subjects did not believe that they would be shocked and responded slowly to the first test of the shock series, but never to the second.

Tension Ratings. At the conclusion of the experiment, *S* was asked to make a self-evaluation of the degree of his tenseness. He was asked to place a check mark in one of the three categories: as to whether he was (1) extremely tense or nervous; (2) moderately tense or nervous; (3) not worried to any degree. *E* made a similar rating prior to that of *S* based on *E*'s opinion of how tense *S* was. This rating was evaluated on the three series, though *E* was undoubtedly influenced more by the shock-imposed series, for this tended to make *S* more tense than the other series. Finally, *S* was requested not to divulge that shock was used in the experiment.

Experimental Results and Discussion

On the basis of the pooled judgments of *E* and *S* as to the degree of emotional tension felt during the experimental period, the total group was divided into the most and the least tense halves, namely extremely tense versus only moderately tense or not tense at all. (By a fortunate coincidence, this divided the group exactly in half.) These halves will hereafter be called the tense and the non-tense groups for simplification of discussion.

The factors of emotional tension used by *E* in evaluation were false starts, perspiration, undue worried or apprehensive appearance, swearing or quick and hurried speech after shock, gasps, requests to wait, leaving the stool through the excitement of participation, trembling hands, and similar observations. The most extreme cases were easily recognizable from the less extreme. A few individuals became so emotional that it was difficult for them to continue the experiment. False starts were not uncommon; one *S* reacted before the stimulus light 29 times. It will be recalled that *E* could not have been influenced in his judgment by the self-evaluation of *S* as his evaluation was made first.

Using the high tension-low tension dichotomy, the phi coefficient[2] between the ratings of *S* and *E* was 0.97, showing a very high correlation between the two independent ratings.

[2] The use of the phi coefficient is adequately described in most elementary statistical textbooks, as for example, Guilford, J. P., *Fundamental Statistics in Psychology and Education*. New York: McGraw-Hill Book Co., 1942.

Reaction and Movement Time. With shock used to cause the emotional tension and knowledge of when the shock could be avoided by fast response serving as a motivational influence, there was a statistically significant difference between the tense and the non-tense groups in the motor response to the stimulus (*TT*). The mean improvement in performance for the tense group was 0.334 seconds, and for the non-tense group 0.239 seconds. The resultant *t*-ratio of 2.07 was statistically significant. Since the hypothesis being tested involves direction, a *t* of 1.68 would be the criterion for the 5-per-cent level of confidence.

However, when the motivating shock came at irregular intervals in the series of reactions and *S* knew that he could not avoid it by improving speed of motor response, the results were quite different. Although both the tense and the non-tense groups improved considerably in *TT* (mean improvements of 0.280 seconds and 0.214 seconds, respectively) the difference between them was not statistically significant ($t = 1.11$). The small improvement, compared to the shock prevention series result, is in accord with the "information" hypothesis of the cause of the improvement due to motivation that has been suggested by Henry (9).

This hypothesis, however, does not attempt to explain why the tense group had a faster motor response than the non-tense group. However, if it be postulated that the tense group was more highly motivated by the shock than was the case in the non-tense group, this would explain the results. It is possible that both the information value of the motivating stimulus and the degree of motivation achieved can play a part in determining the effectiveness of the situation in causing an improvement in the motor response. In Henry's experiment (9), there was no attempt to estimate the amount of motivation produced by the different stimuli that he used, and his motivating stimuli were very small compared with the shock used in the present experiment.

In the shock-prevention series, the mean *RT* of both the tense and the non-tense groups improved (0.032 and 0.025 seconds) although the differences were not significant. When the shock occurred at irregular intervals (shock-imposed series) both groups again improved in reaction time (0.001 and 0.003 seconds), but not as much as in the shock prevention series. The difference between groups was not significant ($t = 0.23$).

Similar results were found for net movement time. There was considerable improvement in performance in both groups, the tense group in the shock prevention series exhibiting a mean decrease of 0.297 seconds and the non-tense group 0.214 seconds ($t = 1.87$). The mean improvement was somewhat less in the shock-imposed series and the tense and the non-tense groups did not differ significantly ($t = 1.33$).

These results show that the improvement in performance in both groups is statistically significant in the shock prevention series in the complete motor response (*TT*), and that the tense group improves more than the non-tense group; but there are no significant differences between the groups in improvement in the two fractions of the motor response, namely *RT* and *MT*. The explanation of these results may be that when in a state of emotional tension, as *Ss* try to improve, a particular *S* may tend to emphasize either the reaction

phase of the speed of response or the movement phase, rather than both. This possibility has been suggested by Fairclough (7) in explaining the results of a "transfer of motivation" experiment.

TABLE 2

Statistical Summary—Reaction Time, Movement Time, Total Time, and Change Owing to Shock Motivation

Reaction Time

Group	Without shock	Shock prevention	Difference	t	Biserial correlation
Tense	0.223	0.190	0.032	0.88	—
Non-tense	0.220	0.195	0.025	—	—
Group	**Without shock**	**Shock imposed**	**Difference**	t	**Biserial correlation**
Tense	0.223	0.222	0.001	0.23	—
Non-tense	0.220	0.217	0.003	—	—

Movement Time

Group	Without shock	Shock prevention	Difference	t	Biserial correlation
Tense	0.780	0.483	0.297	1.87	—
Non-tense	0.693	0.479	0.214	—	—
Group	**Without shock**	**Shock imposed**	**Difference**	t	**Biserial correlation**
Tense	0.780	0.499	0.281	1.33	—
Non-tense	0.693	0.481	0.212	—	—

Total Time

Group	Without shock	Shock prevention	Difference	t	Biserial correlation
Tense	1.003	0.669	0.334	2.07	$r = 0.35$
Non-tense	0.912	0.673	0.239	—	—
Group	Without shock	Shock imposed	Difference	t	Biserial correlation
Tense	1.003	0.723	0.280	1.11	—
Non-tense	0.912	0.698	0.214	—	—

NOTE: Correlations were not computed in cases where the t ratio indicated no significant differentiation.

If this is so, the total motor response may be speeded up more consistently than either of the two separate phases of the response, and there should be a tendency for a negative correlation between RT and MT. This hypothesis was substantiated when the correlation between MT and RT in the tense group in the shock prevention series was found to be -0.369 and in the non-tense group -0.489. These were both significant at the 5 per-cent level of confidence.

Similarly the correlation in the shock-prevention series was $r = -0.382$. Due to the increased number of cases ($N = 50$) this was significant at the 1-percent level of confidence. In ordinary experimental circumstances, there is no correlation between *RT* and *MT* (9).

Both groups, then, showed significant improvements in speed of motor response as a result of electric shock. The tense group improved 33.3 per cent over pre-shock times when the shock occurred at regular intervals and the non-tense group improved 26.2 per cent. The fact that motivation does improve *RT*, *MT*, and *TT* has already been demonstrated (7, 8, 9, 13), but the electric shock used to cause motivation in these experiments was not as severe as that used in the present study.

Physiological Correlates. The physiological responses—namely, changes in heart rate, blood pressure, pulse rate, breathing rate and skin resistance occurring as a result of the motivating stimuli—were compared as between the tense and the non-tense groups. It should be mentioned that these measures were taken after, rather than during, the electric shock.

There was no significant difference between the two groups in any of these measures, in either series, with two exceptions. In the shock-imposed series, the mean pulse rate of the tense group increased 0.81 beats and that of the non-tense group decreased 0.27 beats. The *t*-ratio of 2.12 was significant at the 0.05 level of confidence, though the biserial correlation between the tense and the non-tense groups and pulse rate was low ($r = 0.36$). In the shock-prevention series, the tense group decreased 30,116 ohms and the non-tense group decreased 18,337 ohms in skin resistance. Although the statistical significance of the difference is high (a t of 3.55, significant above the .01 level of confidence) the biserial correlation is low ($r = 0.49$). A similar difference was found in the shock-imposed series, the *t*-ratio being larger (3.84) and the correlation higher ($r = 0.61$).

The practical significance of these physiological measures is not as high as that of the independent ratings of *S* and *E* as to the degree of emotional tension.

Need for Further Work. The area of this investigation, involving study of the influence of emotion and tension, is one of direct concern to research workers in physical education. Performances under stress, the limits of tenseness at which improvement occurs, and the various motivational influences and their importance have not been investigated to any great extent in our field. There are difficulties in evaluating emotional stresses and in producing these stresses in the laboratory, but nevertheless much can be done and is needed in this particular field.

Summary and Conclusions

Fifty male students, age 17 to 30 years, were tested for speed of motor response in a laboratory situation in which they were made emotionally tense by a heavy electric shock ranging from 7 to 16 milliamperes. The complete motor response and the two phases of the response, reaction time and movement time, were measured for each individual in three situations. Fifteen trials were

performed without shock and without information that shock would be given later (*without shock*), ten trials were given when the electric shock was known to occur regularly after a post-stimulus delay corresponding to the average of previous responses (*shock prevention*) and ten trials were made in which the shock occurred at irregular intervals between the onset of the stimulus light and the cessation of movement (*shock-imposed series*).

Measures of breathing rate, systolic and diastolic pressures, pulse rate, and electrical skin resistance were taken at regular intervals, as possible physiological correlates of emotional tension. At the conclusion of the experiment, *S* and *E* made independent ratings as to whether the shock made *S* extremely tense, moderately tense, or caused no tension. On the basis of these ratings *Ss* were separated into the most tense and the least tense halves of the total group. The phi coefficient between the rating of *S* and *E* was very high, namely 0.97.

The results showed that there was a statistically significant difference between the two groups in mean improvement owing to motivation in the knowledge series, with respect to the complete motor response ($t = 2.07$). The tense group improved 33.3 per cent and the non-tense group only 26.2 per cent. In the shock-imposed series the difference was not significant. The corresponding differences in *RT* and in *MT* were not significant. To explain these results, it was postulated that some individuals must have tended to emphasize speeding up the reaction phase and others must have emphasized the movement phase of the total motor response. A negative correlation was therefore predicted between reaction time and movement time, and found to be present ($r = -0.382$).

There were no significant differences between the two groups in changes caused by emotional tension in any of the physiological measures except pulse rate ($t = 2.12$, no-knowledge series) and skin resistance (both series, t's = 3.55 and 3.84). The biserial r between skin resistance change and ratings of tension was 0.49 in the shock-prevention series and 0.61 in the shock-imposed series.

TABLE 3

Statistical Summary of the Differences in Skin Resistance between the Tense and the Non-Tense Groups

Skin Resistance

Group	Resting	Without shock	Difference	t	Biserial correlation
Tense	83,960	61,983	21,977	1.6	$r = 0.30$
Non-tense	52,080	38,823	13,257	—	—
	Resting	Shock prevention	Difference	t	Biserial correlation
Tense	83,960	42,065	41,895	3.55	$r = 0.49$
Non-tense	52,080	33,742	18,338	—	—
	Resting	Shock imposed	Difference	t	Biserial correlation
Tense	83,960	31,842	52,118	3.84	$r = 0.61$
Non-tense	52,080	32,221	19,859	—	—

The "information" hypothesis served to explain the greater improvement in motor response in the shock-prevention series, but not the faster response of the tense group. In the latter case, it was postulated that the members of the tense group improved more because they were more highly motivated.

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Leg Lift Strength: A Comparison of Measurement Methods

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IT IS OCCASIONALLY profitable to re-investigate old, accepted tests. Leg lift strength, measured with a dynamometer, has been a familiar element in strength tests and various indices in physical education for many years. Several authors have presented standard instructions for administering the test.[1, 2, 3, 4]

Two articles in 1938 produced changes in the testing technique. The article by Carpenter[5] presented evidence that high scores from a group of subjects, using the "old" method without the belt, were obtained most consistently with angles at the knee between 115 and 124 degrees. Since then, an angle of about 120 degrees has been generally accepted. The other article introduced the use of the belt. After citing the difficulties in administering leg lift strength tests and referring to some research showing that leg lift strength was the most valid test of athletic ability in the entire P.F.I. battery[6] Everts and Hathaway stated, "Since the new belt gives both a higher score and a more valid test it increases (a) the validity of the P.F.I. as a measure of general health; and (b) the validity of the Strength Index (S.I.) as a measure of athletic ability."[7] No one would question that the use of the belt gives a higher score; but an increase in score does not insure an increase in validity, nor would an increase in score or in validity in one item of a battery necessarily increase the validity of the battery to predict an abstract criterion. Later they stated, "One subject, whose leg-

[1] C. H. McCloy, *Tests and Measurements in Health and Physical Education*. Appleton-Century-Crofts, Inc., Second Edition, 1942. p. 31–32.

[2] T. K. Cureton, Jr. *Physical Fitness Appraisal and Guidance*. St. Louis: The C. V. Mosby Co., 1947. p. 364–365.

[3] H. Harrison Clarke. *Application of Measurement to Health and Physical Education*. New York: Prentice Hall, Inc., Second Edition, 1950. p. 161–162.

[4] Leonard A. Larson and Rachael D. Yocom. *Measurement and Evaluation in Physical, Health and Recreation Education*. St. Louis: The C. V. Mosby Co., 1951. p. 93.

[5] Aileen Carpenter, A Study of Angles in the Measurement of the Leg Lift, *Research Quarterly*, 9, 3: 70–72 (Oct. 1938).

[6] Attributed to Cureton, but source not cited.

[7] Edgar W. Everts and Gordon J. Hathaway, "The Use of a Belt to Measure Leg Strength Improves the Administration of Physical Fitness Tests," *Research Quarterly*, 9, 3: 62.

strength is 1200 pounds with the old method has lifted 2500 pounds with the belt. This illustrates the increase in validity of the new method."[8] They presented no evidence that the increased lifts recorded from this and other subjects approximated more closely than the old method the amount of dead weight these subjects could lift under similar conditions, or that this subject could actually lift a dead weight of a ton and a quarter. In short, they presented no objective evidence that the validity was increased, but rested their case on the logic that bigger is better.

Leg lift strength as measured by the "old" method may fall short of the weight a person could lift under more favorable conditions. The belt may improve the conditions. But there is still a question whether scores with the belt may not represent something above and beyond the weight these subjects could actually lift with their legs. Although the validity of the leg lift test with the belt is as open to question as the test without, there is an equally interesting problem, namely: Why such high, and possibly suspiciously high, scores occur when the belt is used? In other words, the subject may be aided by the belt in getting a vertical component measured by the dynamometer from muscular actions which in themselves have no vertical, or lifting, component.

Anyone who has taken or given the leg lift knows that it is difficult to keep the handle at the hips, especially for long-armed subjects. The use of the belt may (1) produce more favourable conditions under which the subject can lift, (2) make the conditions more uniform between subjects, and (3) increase administrative efficiency. But it might also alter the internal leverage relations, or it may help to provide a vertical component from muscular forces which otherwise could not be used for lifting. It is difficult to see how fixating the dynamometer handle relatively securely with a belt at hip level would alter the internal leverage relations. Better fixation might assist in the application of muscular force and produce a greater measured lift by preventing the handle from slipping down the thighs. However, it might also facilitate the inclusion in the measured lift of the resultant of a force which is not primarily a lifting force.

How a spurious, non-lifting force could be magnified, and facilitated in its application, by the use of the belt, is shown in Figure I, drawn to scale from a subject six feet tall, and the dynamometer used in the experiment. With the extensor muscles at maximum tension, the lower limb from hip to ankle would approximate a fixed lever which could withstand a tremendous compression force. Under these conditions, if the subject developed a quick, forceful backward impulse at the hips—lunged backward, this force would be magnified about six to one by the power arm (hip to ankle distance, about 24 inches) and the weight arm (ankle to dynamometer distance, about 4 inches). Thus, whatever backward thrust could be developed under these conditions would be greatly magnified: a backward thrust of 50 pounds would be recorded as 300 pounds added lift. With a belt securing the handle at hip level, the dynamometer resistance would act primarily as a compression force on the bones; it would tend to increase proportionally with the increase in the measured lift, and would

[8] *Ibid.*, p. 66.

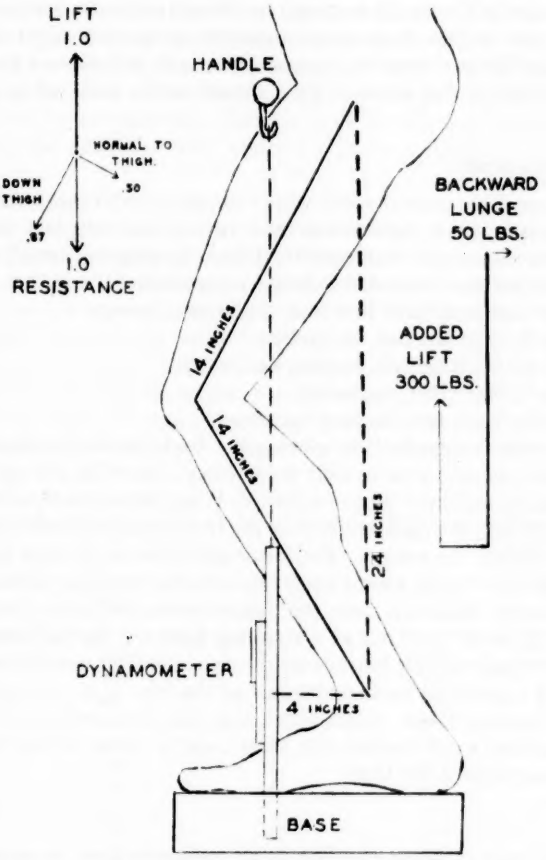

Fig. I. Mechanical Relations in Leg Lift

stay within the limits of strain of the anatomical system—lower limb bones and tensed knee extensor muscles. Similarly, a backward lunge without the belt should produce some increase in the measured lift since the magnification of the force would be the same, *if* the subject could hold the handle fixed. Without the belt, the dynamometer resistance would have a large component tending to slide the handle down the thighs, and the effective component of the spurious force, which would appear in the measured lift, would depend primarily on the subject's ability to prevent the handle from slipping.

Standard conditions call for a vertical lift, but this is difficult because the bottom end of the dynamometer is fixed to the base ahead of the subject's ankles. As the subject attempts to lift vertically, the dynamometer resistance reacts to pull him forward as well as down. The leaning or lunging back which

normally occurs in the leg lift is caused by the subject's attempt to compensate for the reaction of this off-center arrangement. A subject might hit the right combination of lift and lunge by chance, or through skill derived from practice; but the resultant of this spurious force should not be included in a test of leg lift strength.

Purpose of the Study

The purpose of the present study was to compare leg lift measurements under two conditions in which the belt was used, two in which the belt was not used, two in which the subject was prevented from lunging backward, and two in which the subject was instructed to attain a maximum lift and then lunge backward. These were combined into four conditions, namely:

Condition A: without belt, controlled.
Condition B: without belt, lunging backward.
Condition C: with belt, controlled.
Condition D: with belt, lunging backward.

The lifts were "controlled" by placing the back of the dynamometer platform against a smooth wall so that the subject's buttocks slid up the wall as he lifted, and he could not lunge backward. When the subjects were instructed to lunge backward, the base was held at the front by an assistant and a spotter was placed behind the subject. The latter procedure may have increased the measured effect of the backward lunge beyond what could be obtained without the base secured. However, since the dynamometer resistance has a forward component, it would itself act as a restoring force for the backward lunge. A subject might maintain his balance on the dynamometer unaided even though he developed a powerful backward thrust at the hips, *if* it were quick. A relatively slow backward lean would upset him, but the mechanical relations of the dynamometer would restore him from a quick thrust before the center of gravity moved outside the base.

Method

Seventeen male students enrolled in an indoor-outdoor recreational sports course were used as subjects. They were unselected professional students and represented a fairly wide range of strength, ability and body type. A standard (G. Tiemann and Co.) back and leg lift dynamometer was used. Since the scores were to be used only for group comparisons, it was not calibrated.

Each subject was tested under each of the four conditions, with four subjects being tested under Condition A the first day, four under B, four under C, and five under D. The sub-groups were then rotated to equate intraserial practice and fatigue effects. Tests were given on Monday and Thursday of two weeks. Each subject was encouraged both before and during his lifts to lift his maximum on each trial. Two or three trials were given under each condition and the best score recorded. The subjects were told that we wanted to compare their best lifts under the different conditions, but they were naïve as to the actual hypothesis under test. The angle at the knees was kept about 120 degrees for all lifts.

The analysis of variance for several matched groups (F test) was used to determine whether significant differences occurred between the conditions.[9] The *t* ratio was computed by the difference method for paired observations to determine whether these differences were significant pair by pair.[10] Correlations were computed by the raw score formula to determine the degree of relationship between the subject's scores under the four conditions.[11]

Results

The leg lift strength measurements of the seventeen subjects under the four experimental conditions are presented in Table 1. The subjects were arranged in order of their performance under Condition A—without belt, controlled—simply because this condition provided the lowest average score. When lunging back was added without the belt (Condition B), the average performance rose slightly, about 30 pounds; but the standard deviation and the coefficient of variability (100 S.D./M) decreased. Possible reasons why only a slight advantage in lift resulted from lunging back without the belt, and why the variability decreased will be discussed later. Use of the belt increased the measured lift

TABLE 1

Measurements of Leg Lift Strength in Pounds Under Four Conditions

Condition	A	B	C	D
Subject	No Belt Controlled	No Belt Lunging Back	With Belt Controlled	With Belt Lunging Back
1	925	750	1280	2000
2	900	940	1110	1660
3	815	715	740	1250
4	765	690	835	1940
5	750	860	1100	1425
6	700	812	1315	1440
7	700	745	940	1040
8	690	660	790	1360
9	685	700	1010	1330
10	680	815	960	1470
11	660	580	810	1480
12	615	700	1380	1950
13	580	620	1150	840
14	555	600	875	1035
15	550	650	635	910
16	540	670	1170	1290
17	535	650	930	915
Total	11,645	12,157	17,030	23,335
Mean	685.0	715.1	1,001.8	1,372.6
S.D.	115.6	72.5	207.1	352.7
V (100 σ/M)	16.9	10.1	20.6	25.7

[9] Allen L. Edwards. *Statistical Analysis for Students in Psychology and Education.* New York: Rinehart and Company, Inc., 1946. p. 225–232.

[10] *Ibid.*, p. 172–180.

[11] *Ibid.*, p. 90–91.

(Condition C and D), but it also increased the variability, both absolute and relative. The increase with the belt, controlled (about 300 pounds over Condition A) was to be expected. However, while four subjects above the mean under Condition A exceeded the mean under Condition C., four subjects who were at or below the mean under Condition A also exceeded the mean under Condition C; Subject 12 had the largest recorded lift, while Subject 3 lifted less with the belt, controlled, than he had without the belt. The increase in the coefficient of variability under Condition C may be associated with the decrease under Condition B. The increase with the belt and lunging backward (about 370 pounds more than with the belt, controlled) was predicted in the introduction.

The analysis of variance of the leg lift strength measurements under the four conditions (Table 2A) gave a value of F which was significant well beyond the 1 per cent level. The data acted as if the conditions produced significant group differences in performance. The analysis of variance in Table 2B, in which the residual sum of squares was used to obtain the estimates of variance, gave significant values of F at the 1 per cent level for both the sum of squares by columns (conditions) and by rows (individuals). The data were not only acting as if the different conditions produced significant group differences, but also as if the conditions affected the performances of individuals differently. However, without some *a priori* hypothesis concerning the possible effect of different conditions on different types or classifications of individuals, and without more than one individual in each type (replication), we could not justifiably call the residual sum of squares "interaction" and interpret the significant value of F for individuals as evidence that the different conditions affected

TABLE 2A

Analysis of Variance of Leg Lift Strength Under Four Conditions

Source of Variation	Sum of Squares	df	Estimate of Variance	Between/Within F = 34.52
Between groups	5,210,936	3	1,736,978	F to be signif. at:
Within groups	3,220,528	64	50,321	5% level = 2.75 1% level = 4.11
Total	8,431,464	67		

TABLE 2B

Source of Variation	Sum of Squares	df	Estimate of Variance	Columns/Residual F = 50.26
Between columns (conditions)	5,210,936	3	1,736,978	F to be signif. at:
Between rows (individuals)	1,561,717	16	97,607	5% level = 2.80 1% level = 4.22
Residual (interaction)	1,658,818	48	34,558	Rows/Residual F = 2.82
Total	8,431,464	67		F to be signif. at: 5% level = 1.86 1% level = 2.40

different "types" of individuals differently, or that we had "interaction".[12] Although it appeared from the data and from the analysis of variance as though the different conditions affected different individuals differently, there remained a good question whether some *a priori* basis for classifying individuals into types, which would permit interpretation of the "residual" sum of squares as "interaction", would bear this out.

The significance of the difference between group (condition) means was tested pair by pair (Table 3). With one exception (A-B), the differences were significant well beyond the 1 per cent level. The exception (A-B) was significant at the 20 per cent level.[13] Lunging back without the belt (B) failed to produce a significant increase over Condition A because either the sample was limited or the force of the lunge was dissipated. We may conclude that the significant differences were not chance differences even though the different conditions affected both the means and variabilities of the group.[14]

If the performances of the subjects tended to place them in the same relative order regardless of the conditions under which they were tested, measurements under one condition could be used to estimate measurements under one of the other conditions—as McCloy implies in presenting his correction table.[15] To determine the degree to which measurements under the different conditions were commensurate, raw score correlations were run between the paired measurements. (See Table 4.) Although the sample was too small to justify any involved interpretation of the individual correlations, six low to moderate, positive correlations resulted.

TABLE 3

t Ratios Between Paired Conditions

Condition	A	B	C	D	For 16 df: To be signif. at:
A					5% level = 2.120
B	1.348				1% level = 2.921
C	5.761	6.013			
D	9.381	8.019	4.332		

TABLE 4

Raw Score Correlations Between Conditions

Condition	A	B	C	D
A				
B	.089			
C	.188	.414		
D	.575	.388	.433	

[12] Allen L. Edwards, *op. cit.*, p. 230.

[13] R. A. Fisher. *Statistical Methods for Research Workers.* Edinburgh: Oliver and Boyd, 1930. Table IV, p. 139.

[14] Allen L. Edwards, *op. cit.*, p. 295.

[15] C. H. McCloy, *op. cit.*, Table LI, pp. 383–385.

The one factor common to the four conditions was that each required a leg lift. However, if this were the *primary* component in the performances under different conditions, one would expect the correlations as a group to be higher. Furthermore, one would expect the correlations having common factors to be larger, but the data failed to support this. The correlation between lifting without belt, controlled and lunging backward, has practically zero (.089). The correlation for lifting "controlled," with and without the belt, was low (.188). The correlation for lunging backward, with and without the belt, was also low (.388); and the correlation for using the belt, controlled and lunging backward, was also moderate (.433).

Oddly enough the highest correlation (.575) occurred where it would be expected least—between lifting without the belt, controlled, and lifting with the belt, lunging backward. The group was too small, and perhaps too homogeneous, to give these correlations much meaning. However, collectively they indicated that the performances of this group were considerably more independent under the different conditions than they were dependent on some common factor, or that there were several factors operating at cross purposes in the measurements.

Discussion

It was noted above that lunging back without the belt produced a rather small average increase in the lift, but decreased the variability of the group. Subjects 1 through 8, who were above the mean under Condition A, had a total net gain under Condition B of −73 pounds, while subjects 9 through 17, who were below the mean, had a total net gain of 670 pounds. The mean of the group increased and the variability decreased under Condition B because the poorer lifters under Condition A increased their lifts considerably when instructed to lunge backward, whereas the better lifters retrogressed slightly. Without the belt to assist in holding the handle at the hips, the resistance of the dynamometer (which would equal the lift) would act primarily as a force to slide the handle down the thighs. (See Figure I.)

The greater the lift, the greater the resistance would be, and the greater the problem of holding the handle secure and taking advantage of the backward thrust. With no backward thrust possible and the handle secured by the belt (Condition C), a larger average lift resulted and greater variability than under Condition A. If the problem of the handle slipping down the thighs were a problem in Condition B, it was also a problem in Condition A. Regardless of the force from the backward lunge, lifting without the belt seems to be in part a matter of how well the man can hold the handle fixed, as well as how much he can lift.

The experimental results demonstrated that instructions to attain a maximum lift and then lunge backward produced sizable increases in the measured lift. This effect was most apparent when the belt was used because the belt fixated the handle at the hips and favored getting the maximum out of this spurious force applied through a leverage that magnified it. There seemed to be individual differences in the ability to develop and use this force, and this was most ap-

parent when the belt was used. It might be argued that holding the platform and using a spotter were not standard procedure and tended to bias the data.

However, as the test is administered generally, there is no assurance that the subject does not develop and use some backward thrusting force, which is then magnified and recorded as part of the lift. If this force were developed quickly and skillfully applied, the dynamometer resistance would restore the subject quickly to equilibrium; and his backward movement at the hips would be equal to about one sixth of the distance the dynamometer gives in measuring this added "lift", a relatively small distance. The mechanical relations of the dynamometer itself require the subject to pull backward to some extent, and many subjects normally finish their lift with a backward lean or thrust. Some, and possibly many, subjects might have used a backward thrust even without instructions unless prevented from developing and using this spurious force. This would be extremely difficult for an observer to determine as long as the subjects hips were free to move backward. However, "controlling" this by requiring the subject to slide up a smooth wall would appear to eliminate the possibility of using this spurious force. The lifts under Condition C were large, but perhaps reasonable; those under Condition D were spuriously high, but not unusual for lifts with a belt.

If the logic that bigger is better were accepted, use of the belt *plus* instructions to attain a maximum lift and then lunge backward might appear the most "valid" measure. Although we should be concerned with the validity of tests, the measures taken here provided no basis for recommending the most valid measure, or even a valid measure. The problem of a valid measure of leg lift strength is still open. However, the evidence here, aside from showing that leg lift measurements as taken may contain some component from a spurious force, suggested that these measurements may also represent the interaction of several factors other than ability to lift.

Summary and Conclusions

The possibility that leg lift strength as measured with a dynamometer, with or without the belt, might contain the resultant of a spurious (non-lifting) force acting through a leverage which magnified its effect was discussed. A rotated group experiment was run to compare leg lift measurements under two conditions in which the belt was not used, two conditions in which the belt was used, two conditions in which the lifts were "controlled" to prevent the development and use of a spurious force from a backward lunge of the hips, and two conditions in which the subjects were instructed to attain a maximum lift and then lunge backward. These were combined into four conditions, namely: Condition A, without belt, controlled; Condition B, without belt, lunging back; Condition C, with belt, controlled; and Condition D, with belt, lunging back.

Seventeen male, physical education majors were used as subjects. They were unselected and represented a fairly wide range of strength, ability, and body type. All subjects were encouraged before and during the lift to attain a maximum lift under each condition, and were naïve as to the hypothesis under test.

An angle of approximately 120 degrees at the knee was used, and the best of two or three lifts under each condition recorded.

Analysis of the experimental data showed that:

1. The average lifts under Conditions A, B, C, D were, respectively, 685.0, 715.1, 1001.8 and 1372.6 pounds. The standard deviations were, respectively, 115.6, 72.5, 207.1 and 352.7 pounds; and the corresponding coefficients of variability were 16.9, 10.1, 20.6 and 25.7. The increase in mean lift when the belt was used (Conditions C and D) over corresponding conditions without the belt (A and B) was expected on the basis of previous reports. The increase in mean lift when the lunge was introduced (Conditions B and D) over corresponding conditions without the lunge (A and C) was predicted in the introduction.

2. The analysis of variance for between group divided by within group estimates of variance gave a value of F which was significant well beyond the 1 per cent level. The data acted as if the conditions produced significant group differences. The analysis of variance in which the residual sum of squares was used gave significant values of F at the 1 per cent level for both the sum of squares by columns (conditions) and by rows (individuals). The data also acted as if the different conditions affected the performance of individuals differently. There was additional evidence on this point. However, without some *a priori* basis for classifying individuals into "types," and without more than one individual in the "type" classifications (replication), we were not justified in terming the residual sum of squares "interaction," or in interpreting the significant value of F for individuals as evidence that the different conditions affected different "types" of individuals differently.

3. The significance of the differences between group (condition) means was tested pair by pair (t ratio). With one exception (A-B), the differences were significant well beyond the 1 per cent level. Even though the different conditions affected both the means and the variabilities of the group, we may conclude that the significant differences between means were not chance differences. The exception was interesting since it raised a question whether the difference between lifts under the two conditions without the belt, controlled and lunging backward, failed to differ significantly because the sample was small or because the lunge backward without the belt would, in general, fail to increase the measured lift significantly. (See 5 below.)

4. Raw score correlations between performances under the four conditions gave six low to moderate, positive correlations (r_{ab} = .089; r_{ac} = .188; r_{ad} = .575; r_{bc} = .414; r_{bd} = .388; and r_{cd} = .433). These correlations indicated considerably more independence of performance under the four conditions than they did dependence on a common factor, ability to lift with the legs.

5. The experimental results suggested strongly that leg lifts as measured without the belt may contain factors other than ability to lift with the legs. One of these seemed to be ability to hold the handle relatively fixed at hip level, which was progressively more difficult as the dynamometer resistance, and measured lift, increased. A second seemed to be the ability to develop and apply the spurious force from a backward thrust of the hips, the measured effect of which depended in part on ability to hold the handle at hip level.

6. Leg lifts with the belt probably eliminated the effect of ability to hold the handle fixed as a limiting factor in the measured lift, but enhanced the measured effect of ability to develop and use a spurious force—lunging backward. In lifts where lunging backward was controlled (Condition C), the lifts were, on the average, considerably higher than under Condition A, but perhaps reasonable. When lunging back was added with the belt, a large spurious component (which averaged about 375 pounds) was introduced intentionally into the measured lift. Although the lifts under Condition D would not be considered unusually large for lifts with the belt, there was a question whether lifts with the belt as usually administered might not contain some spurious component, which was greater with the belt than without. This suggested that lifts with the belt, as usually administered, might be spuriously large. However, the problem of the validity of the lifts was not investigated.

7. There was some experimental evidence, as well as logical evidence, that in lifts with or without the belt, the possible inclusion of a spurious (nonlifting) component could be prevented by forcing the subject to slide his buttocks up a smooth wall as he lifted. It would seem advisable to use this positive control, rather than depending on a tester's estimate of whether the lifts were vertical and legitimate.

The Relationship Between Bilateral Contour Asymmetry in the Human Body in Standing and Walking[1]

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THE STRUCTURAL balance of any mechanism is of primary concern to its functional efficiency. In the realm of mechanics this is undisputed. The idea that the structural balance of the human body and its functional efficiency are inter-related is generally accepted by specialists in the field of posture and body mechanics. There is lack of agreement, however, on desirable standards of structural alignment for satisfactory functioning. It is essential to find reliable and valid means of measurement before such standards can be established and before structural balance of the human body can be related to functional efficiency in various types of work and play activities.

The two previous related studies cited briefly below are concerned with reliable and valid means of measuring bilateral body alignment. This study is primarily concerned with the relationship between bilateral alignment as it occurs in standing and in walking.

The fundamental assumptions on which the two previous studies and this study have been based are as follows: (a) The skeletal structure is the framework supporting the weight of the body. Its component parts serve as levers on which muscles act to produce movement and to maintain equilibrium of the body. (b) In any positions the body may assume or in a specific movement it may perform, skeletal alignment and accompanying muscle action are interrelated and interdependent. (c) Bilateral asymmetry tends to occur in skeletal alignment and in body contour of normal individuals in the standing position; it will tend to be reflected in bilateral movement in walking. (d) When asymmetry occurs in one portion of the body it is apt to occur also in other portions of the body. (e) The valid point of reference for the erection of a vertical axis to divide the body into lateral halves is the center of the sacral table where weight of the spinal column and its appended structures is transferred to the left and right sides of the pelvis.

Previous Studies

Two previous studies[2] have utilized radiography and photography in an effort to obtain objective data on bilateral alignment of the human body in

[1] This study was done in partial fulfillment of the requirements for the degree of Doctor of Philosophy in the School of Education, New York University, 1949.

[2] The writer wishes to express appreciation to Dr. Lulu E. Sweigard for her help in this summarization of these two previous studies and during the course of this investigation.

standing. Sweigard (2) studied the problem of bilateral alignment of the skeletal framework in the standing position. She found evidence of bilateral asymmetry at all levels of skeletal alignment in the spine, pelvis, and proximal femora of 500 college men and women ranging in age from 17 to 42 years. Measurements of bilateral asymmetry in relation to a vertical axis through the center of the sacral table showed that the top of the sacrum was the most reliable in its position of any skeletal part ($r = .98$). In general, reliability of asymmetry tended to decrease as distance from the central vertical axis increased and/or the number of joints and intervening skeletal parts increased.

In each of two corresponding age groups in both sexes, the skeletal asymmetries grouped into seven identical patterns. Three of these were minor patterns included in two of the others. Three major patterns (I, II, VI) occurred together to form a general pattern of bilateral skeletal asymmetry. This general pattern included lateral deviation and greater height of the pelvis and proximal femora on the same side accompanied by lateral deviation of the lumbar spine on the opposite side. With an age increment of 25 years, the mean degree of asymmetry in the general pattern tended to increase in men and to decrease in women. The fourth major pattern included asymmetries in the shoulder girdle and upper thorax. With an age increment of 25 years, the mean degree of asymmetries tended to increase in women and to decrease in men. This pattern had little or no relationship to the other patterns except in older women where there was a tendency for the shoulder girdle and upper thorax to deviate in lateral opposition to the lumbar spine.

DuBois (1) studied the extent to which contour asymmetry found in posterior view photographs of the body revealed asymmetry of underlying skeletal structures. The subjects used were a random group of 130 college men, 17 to 22 years of age, used in Sweigard's (2) study. An anterio-posterior radiograph and an enlarged posterior view photograph of the nude body taken immediately following the radiograph were available for each subject.

A method was devised to determine objective contour points of reference for measurement at strategic levels of skeletal asymmetry dividing the trunk vertically into eight equal parts from the top of the gluteal crease to the level of the arm pits. Four more equal vertical divisions were established above and below these levels in the trunk. A method was devised to determine a reference point for a vertical axis on the photograph which would approximate most closely the skeletal vertical axis through the center of the sacral table. The validity of the axis determined by this method was superior to that of an axis erected through the natural landmark at the top of the gluteal crease ($r = .90$, $r = .50$ respectively).

Evidence of bilateral asymmetry was found at all levels of contour alignment. The reliability of contour asymmetries, as in the case of skeletal asymmetries, decreased in general as the distance of parts of the body from the pelvis and from the central vertical axis increased ($r = .96$ to $.65$). Patterns of skeletal alignment were predicted with a high degree of accuracy from specific contour asymmetries as follows: asymmetry of the pelvis and its adjoining parts from horizontal contour asymmetry at the level of the top of the gluteal crease;

asymmetry of the shoulder girdle and upper thorax from vertical contour asymmetry at the shoulder tips; and lateral displacement of the thoracic spine from horizontal contour asymmetry at the base of the neck and at the shoulder tips, and from vertical contour asymmetry of lateral indentations at the waist. Asymmetry of bilateral body contour was found to relate more closely to bilateral asymmetry of skeletal alignment when deviation of the lumbar spine was in lateral opposition to that of the pelvis and femora (r = .62 to .92) than when the lumbar spine was not in lateral opposition to that of the pelvis and femora (r = .40 to .75).

The results of these two studies indicate that bilateral asymmetry can be expected to occur in skeletal and contour body alignment, that bilateral contour alignment in certain portions of the body tends to relate to skeletal alignment and that bilateral asymmetry tends to occur in patterns. These results raise the question as to what patterns of bilateral asymmetry of body alignment occur during a fundamental movement, such as walking, and what the relationship may be between this alignment and the patterns occurring in standing.

The Problem

The purpose of this study is to determine patterns of bilateral contour asymmetry in standing and in walking when body weight is supported alternately on each limb, and the relationships among these patterns.

Amplification of the problem is concerned with the relationship of bilateral contour asymmetry to age, height, weight, handedness, and limb preference in initiating the walk from stance.

Procedure

The subjects were 150 women selected from 774 normal Freshman college women in the University of Illinois to secure range and distribution in age, height, and weight similar to that in the Freshman group. The subjects ranged in age from 16 to 25 years; in height, from 58 to 73 inches; and in weight, from 83 to 186 pounds. The divergence from the Freshman population of the subjects and of the 30 among them selected for experimental purposes was determined by t values and their significant levels of confidence.

Masking tape was placed on the scapular spines, achilles tendons, and on the 7th cervical and 12th thoracic vertebrae of each subject. Posterior view 16-millimeter motion pictures were taken of the subjects in the nude while standing and walking. A plumb line was suspended to appear at one side of the subject's body in each picture. For experimental purposes motion pictures of a random sample of 30 of the subjects were taken at two different times within a week under identical conditions. Enlarged five-inch by seven-inch photographs were made from selected frames of the motion pictures of each subject (1) while standing, (2) while walking when the left limb supported body weight at the moment the swinging right ankle was opposite the left leg, and (3) while walking when the right limb supported body weight at the moment the swinging left ankle was opposite the right leg. The enlargement of the three photographs was made to maintain identical width of the track on

which the camera truck moved, thus showing the figures identical in distance from the camera lens.

PRELIMINARY STUDY

The two sets of photographs of 30 subjects were used for experimental purposes. DuBois' technique (1) of establishing a valid central vertical axis for reference in measurement of bilateral body contour was followed. One exception was made to this technique (see page 45). Since the location of the arm pits was unreliable in walking, a different unit of measurement for vertical division of the trunk was necessary. Experimentation showed that one-sixth the vertical distance between the top of the gluteal crease and the top of the 12th thoracic tape gave a unit of measurement which resulted in the location of one of the reference points for horizontal lines at the upper level of the pelvis; another at its lower level, as in DuBois' study. Horizontal lines drawn through seven points of vertical division above the gluteal crease, one at the top of the gluteal crease, and four below it established 12 contour reference points which served with others for use in measurement.

Twenty-six experimental measurements of contour asymmetry, using $\frac{1}{100}$ inch as their unit, were devised. These were taken on the first and second set of pictures of the three positions of each experimental subject. To determine the reliability of asymmetries the results of the measurements taken on the first set of pictures were correlated by the Pearson product-moment formula with results of corresponding measurements taken on the second set of pictures of the same subjects. On the bases of non-duplication of asymmetries and an arbitrarily established coefficient of reliability of asymmetries of .70 or better, the measurements were then reduced in number to 20 which were retained for the final study (see Figure I). These are classified according to type of measurement, with their approximate skeletal location as follows:

Horizontal, in relation to the vertical axis

1. Head, the level determined by its vertical bisection
2. Neck, upper level of 7th cervical tape
3. Shoulder, outer edge of scapular tape
4. Lateral contour level 7, 10th thoracic vertebra
5. Lateral contour level 6, 12th thoracic vertebra
6. Lateral contour level 5, second lumbar vertebra
7. Lateral contour level 4, third lumbar vertebra
8. Lateral contour level 3, 4th lumbar and iliac crests
9. Lateral contour level 2, upper sacrum
10. Lateral contour level 1, 2nd sacral and upper ilia
11. Lateral contour level 0, top of gluteal crease and mid-sacrum
12. Lateral contour level −1, femoral joints
13. Lateral contour level −2, great trochanters
14. Lateral contour level −3, small trochanters
15. Lateral contour level −4, proximal femora
16. Distal femora, innermost point on outer lateral contour above knee joints

Vertical, in relation to an objectively established level

17. Shoulder, outer edge of scapular tape to level of 12th thoracic tape
18. Knee, at innermost point on outer lateral contour above knee joint to level of lower edge of corresponding heel; in the swinging knee in walking, from the same reference point on the distal thigh to level of lower edge of supporting heel

Angulation

19. Left foot, upper angle formed by a vertical through innermost point of heel tape and one through the base of the heel tape and the outermost toe contour
20. Right foot, upper angle as described in number 19

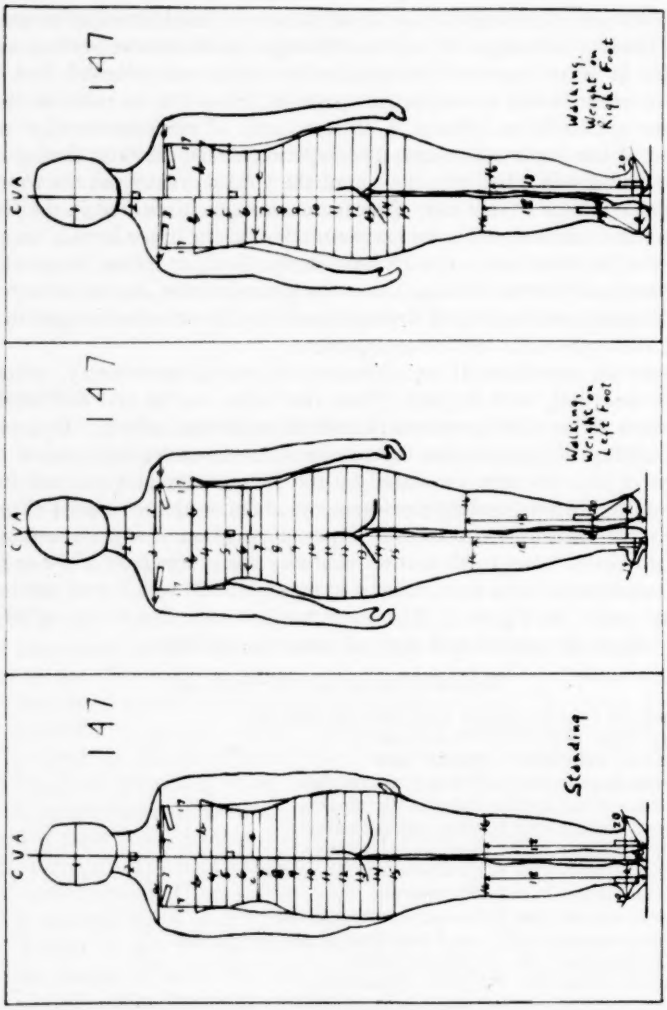

FIG. I. Location of Identical Measurement Lines on Photographs

THE FINAL STUDY

Measurements were taken on all the photographs after objective levels and the central vertical axis had been determined and marked. The asymmetries were determined and organized into three groups according to the three positions being studied.

The asymmetries in each group were intercorrelated. Since the intercorrelation data of each group revealed clusters of asymmetries showing a high relationship with each other and a less degree of relationship with other asymmetries, the correlation data were subjected to factor analysis by the Thurstone centroid method as a means of determining patterns of asymmetry and of identifying the factor common to each pattern.

The relation of corresponding patterns of bilateral contour asymmetry in the three positions was found by determining first, through multiple correlation, the fewest possible asymmetries to predict each factor common to standing and walking; then by computing score-form multiple regression equations for the asymmetries which best predicted each factor, standard scores which best predicted each factor, and zero-order correlations between these standard scores.

Relationships between bilateral contour asymmetry and height, weight, handedness and limb preference in initiating the walk were determined by zero-order and biserial correlations.

Results

A study of the data gathered in this investigation reveals patterns of bilateral contour asymmetry and their interrelationship in standing and walking.

RELIABILITY OF BILATERAL CONTOUR ASYMMETRY

Table 1 shows, in order of location in the body, the reliability of asymmetries in standing and in left and right limb support in walking. In all three positions, asymmetry 9 at the upper sacral level tends to be the most reliable. In general, in each position asymmetries tend to decrease in degree of reliability as they occur farther from the upper sacrum. Exceptions to this occur in

TABLE 1

Reliability of Bilateral Contour Asymmetry of 30 Experimental Subjects, Standing and Walking

Contour asymmetry	Standing	Walking, left limb	Walking, right limb
1. Head	.78	.78	.90
17. Shoulder height	.90	.87	.90
3. Shoulders	.79	.76	.75
2. 7th cervical	.74	.81	.70
4. 10th thoracic	.72	.86	.72
5. 12th thoracic	.73	.87	.77
6. 2nd lumbar	.77	.86	.78
7. 3rd lumbar	.85	.91	.80
8. Iliac crests	.77	.91	.83
9. Upper sacrum	.95	.95	.93
10. 2nd sacral	.93	.91	.89
11. Mid-sacrum	.92	.91	.89
12. Femoral joints	.83	.91	.85
13. Great trochanters	.91	.92	.85
14. Small trochanters	.88	.91	.87
15. Proximal femora	.94	.90	.89
16. Distal femora	.76	.85	.88
18. Knee height	.86	.92	.92
19. Left foot angle	.73	.75	.81
20. Right foot angle	.72	.89	.85

the areas where parts are joined to the unit of pelvis and spine, and in the supporting limbs: asymmetries at the head, shoulder area, proximal femora, knees, and the swinging right foot. A comparison of reliability of asymmetries in walking with those in standing shows that in general the consistency of asymmetry in walking tends to be greater above the upper sacrum but less below it, than in standing. Exceptions to this occur again at the head, shoulder area, proximal femora, knees and feet. In walking, the proximal femur of the supporting left limb is more reliable in position than that of the supporting right limb. There is greater reliability of asymmetry in the pelvis, proximal femora and upper trunk in left limb support; in the head, shoulders, knees and supporting foot in right limb support.

PATTERNS OF BILATERAL CONTOUR ASYMMETRY

Factor analysis of each of the three groups of data reveals evidence that bilateral contour asymmetry occurs in patterns in standing and in walking when weight is supported either on the left or on the right limb. The clusters of asymmetries with high factor loadings indicate that at least four independent patterns of lateral deviation are necessary to describe bilateral contour asymmetry in standing, and at least three in walking (see Tables 2, 3, and 4). Two occurring in left and in right limb support in walking correspond in all their asymmetries to two occurring in standing.

Pattern I, Lateral Bending. In both standing and walking, Pattern I includes horizontal asymmetries 1 through 7, lateral deviation from the level of the head through the level of the third lumbar vertebra (see Table 5). The movement factor common to the asymmetries of this pattern is identified as lateral bending mainly in the coronal plane occurring in the intervertebral joints of the spinal column. Asymmetries of the pattern in all three positions show lowest

TABLE 2

Rotated Factor Loadings of Bilateral Contour Asymmetries of 150 Subjects, Standing

Asymmetry no.	I″	II′	III′	IV″	Unrotated h^2	Rotated h^2
1	.7466	.2009	.5109	.0608	.8621	.8602
2	.8307	.2262	.5023	−.0145	.9933	.9920
3	.8608	.0315	−.0530	−.0850	.7524	.7505
4	.9343	.1214	−.1391	.0053	.9069	.9062
5	.8725	.1882	−.1755	.0902	.8359	.8343
6	.8769	.3187	−.3141	.2007	.7980	.7961
7	.5901	.5100	−.2827	.1768	.7191	.7186
8	.2966	.7988	−.2076	.1106	.7808	.7793
9	.1993	.9052	−.1120	.0703	.8760	.8760
10	.1544	.9414	−.0662	−.0307	.9147	.9143
11	.1258	.9499	.0131	−.1130	.9301	.9290
12	.0976	.9579	.0159	−.0652	.9309	.9286
13	.1274	.9651	.0065	.0586	.9511	.9506
14	.1613	.9253	−.0567	.0683	.8894	.8892
15	.1190	.9259	.0190	.1386	.8903	.8890
16	.1703	.8323	.0773	.1285	.7436	.7433
17	−.1849	.0472	.6071	.0430	.4069	.4062
18	−.0336	.0487	−.0976	−.3560	.1398	.1394
19	.2112	.0854	.1206	.2807	.1492	.1445
20	.0597	−.0683	.0928	.6199	.4013	.3995

TABLE 3

Rotated Factor Loadings of Bilateral Contour Asymmetries of 150 Subjects, Walking with Weight on Left Limb

Asymmetry no.	I''	II'	III'	Unrotated h^2	Rotated h^2
1	.3237	.3449	.6647	.6654	.6634
2	.1899	.3277	.7715	.7379	.7370
3	.2215	.2259	.7845	.7152	.7140
4	.0461	.3115	.8767	.8671	.8661
5	−.0604	.3796	.8890	.9377	.9375
6	−.1597	.4450	.8234	.9011	.9005
7	−.1093	.5954	.6771	.8247	.8241
8	−.0819	.8212	.3456	.8007	.7995
9	−.0161	.9388	.1846	.9160	.9161
10	−.0351	.9346	.1251	.8897	.8881
11	−.0425	.9530	.0964	.9196	.9191
12	−.0319	.9641	.0709	.9357	.9350
13	−.0717	.9283	.1432	.8877	.8865
14	−.0863	.9512	.1619	.9386	.9376
15	−.0541	.8908	.2366	.8526	.8506
16	−.0096	.8057	.3033	.7412	.7398
17	−.1963	.0979	−.2461	.1090	.1083
18	.6552	.2402	−.1219	.5016	.5012
19	.0031	.1608	.0245	.0265	.0261
20	.4621	−.0100	.0505	.2142	.2142

TABLE 4

Rotated Factor Loadings of Bilateral Contour Asymmetries of 150 Subjects, Walking With Weight on Right Limb

Asymmetry no.	I''	II'	III'	Unrotated h^2	Rotated h^2
1	.6584	.1506	.1443	.4771	.4761
2	.7693	.1278	.2388	.6605	.6640
3	.7605	.0792	.2234	.6302	.6335
4	.9276	.0873	.0831	.8749	.8736
5	.9498	.1692	−.0749	.9361	.9345
6	.8871	.2670	−.1344	.8762	.8758
7	.7676	.4068	−.0501	.7571	.7555
8	.4779	.7294	−.0919	.7693	.7671
9	.2767	.9140	−.0197	.9127	.9117
10	.2122	.9093	−.0184	.8726	.8714
11	.1465	.9305	.0787	.8940	.8922
12	.1538	.9195	.1613	.8955	.8938
13	.2077	.9423	.0910	.9398	.9383
14	.2295	.9101	.1453	.9027	.9015
15	.2134	.8685	.1848	.8343	.8325
16	.2086	.8073	.1854	.7299	.7286
17	−.2064	.0063	−.3504	.1654	.1649
18	−.0673	−.0235	.4835	.2386	.2372
19	.0474	.0202	.5872	.3472	.3471
20	.1265	.0239	.0877	.0242	.0238

correlation with the movement factor at the upper and lower limits of the pattern; the highest, at the center of the pattern. Asymmetries 4 and 5 at the levels of the tenth and twelfth thoracic vertebrae best predict Pattern I in standing and in walking RO. (4) (5): standing, .97; walking, left limb, .91; walking, right limb, .96.

Lateral location of asymmetries 4 and 5 of Pattern I occurs in the subjects of this study as follows:

Standing	to left, 42%; to right, 48%; to left and right, 10%
Walking, left limb	to left, 20%; to right, 71%; to left and right, 9%
Walking, right limb	to left, 55%; to right, 39%; to left and right, 6%

Pattern II, Coronal Rotation. In both standing and walking, Pattern II includes horizontal asymmetries 8 through 16, lateral deviation from the level of the iliac crests through the distal portion of the femora (see Table 5). This

TABLE 5

Patterns of Contour Asymmetry with High Rotated Factor Loadings in Standing and Walking

Asymmetries	Pattern I			Pattern IV Standing III′	
	Std. I″	Walk l. III′	Walk r. I″		
17. Shoulder height				.61	
1. Head	.75	.66	.66	.51	
2. 7th cervical	.83	.77	.77	.50	
3. Shoulders	.86	.78	.76		
4. 10th thoracic	.93	.88	.93		
5. 12th thoracic	.87	.89	.95		
6. 2nd lumbar	.75	.82	.89		
7. 3rd lumbar	.59	.68	.77		
	Pattern II				
	Std. II′	Walk l. II′	Walk r. II′		
8. Iliac crests	.80	.82	.73		
9. Upper sacrum	.91	.94	.91		
10. 2nd sacrum	.94	.93	.91		
11. Mid-sacrum	.95	.95	.93		
12. Femoral joints	.96	.96	.92		
13. Great trochanters	.97	.93	.94		
14. Small trochanters	.93	.95	.91		
15. Proximal femora	.93	.89	.87		
16. Distal femora	.83	.81	.81		
				Pattern III	
				Std. IV″	Walk l. I″	Walk r. III′
18. Knee height				−.36	.66	.48
19. Left foot angle				.28	.00	.59
20. Right foot angle				.62	.46	.09

tends to be the most consistent pattern found. The movement factor common to this pattern is identified as rotation mainly in a coronal plane occurring primarily in the femoral joints. In both standing and walking, the relationship of the asymmetries to the movement factor decreases at the upper and lower limits of the pattern. Asymmetries 12 and 13 at the levels of the femoral joints and the great trochanters of the femora best predict Pattern II in standing and

in walking. RO. (12) (13): standing, .98; walking, left limb, .96; walking, right limb, .95.

Lateral location of asymmetries 12 and 13 of Pattern II occurs in the subjects of this study as follows:

Standing	to left, 34%;	to right, 58%;	to left and right, 8%
Walking, left limb	to left, 48%;	to right, 45%;	to left and right, 7%
Walking, right limb	to left, 33%;	to right, 57%;	to left and right, 10%

Pattern III, Rotation—Horizontal in Standing, Sagittal in Walking. In standing, Pattern III includes vertical asymmetry 18, difference in knee height, and asymmetries 19 and 20, angles of the left and right feet. In walking, difference in knee height and the angle of only the swinging foot are included in this pattern (see Table 5).

In standing, the movement factor is identified as horizontal rotation at the knee and ankle joints. The angle of the right foot relates more highly to this factor than that of the left foot. Difference in height of the knees relates negatively to the movement factor, that is, as the degree of rotation increases difference in the height of the knees tends to decrease. In walking, the movement factor is identified as rotation mainly in the sagittal plane of the knee and ankle joints of the swinging limb. When weight is supported on the left limb, difference in the height of the knees is more highly related to the movement factor than the angle of the swinging foot. When weight is supported on the right limb, however, difference in the height of the knees is less highly related to the movement factor than the angle of the swinging foot. Thus when the limb which is better centered in standing is swinging in walking, more rotation in the sagittal plane occurs at the ankle than at the knee. No asymmetry, either in standing or in walking, can be used with a high degree of certainty to predict Pattern III.

Lateral location of the asymmetries of Pattern III occurs in the subjects of this study as follows:

Standing:	Knee height—greater left, 53%;	greater right, 29%;	even, 18%
	Foot angle—greater left, 20%;	greater right, 77%;	even, 3%
Walking:	Knee height—greater left, 75%;	greater right, 22%;	even, 3%
	Swinging foot angle—greater left, 67%;	greater right, 27%;	even, 6%

Pattern IV, Sagittal Rotation. Pattern IV occurs in standing only. It includes vertical asymmetry 17, difference in shoulder height, and horizontal asymmetries 1 and 2, lateral deviation at the head and at the level of the seventh cervical vertebra (see Table 5). The movement factor common to this pattern is identified as rotation mainly in the sagittal plane. Lateral deviation of the head shows the highest relationship to the movement factor. None of the asymmetries of Pattern IV can be used with a high degree of certainty in its prediction.

Lateral location of the asymmetries of Pattern IV occurs in the subjects of this study as follows:

Standing:	Head—to left, 38%;	to right, 57%;	even, 5%
	Seventh cervical—to left, 45%;	to right, 50%;	even, 5%
	Shoulders—left higher, 64%;	right higher, 23%;	even, 13%

RELATIONSHIP BETWEEN CORRESPONDING PATTERNS OF CONTOUR ASYMMETRY IN STANDING AND WALKING

Patterns I and II in walking are related to corresponding patterns in standing. Of the various patterns, only these two are in complete agreement in their asymmetries in each of the three positions. In walking, when weight is supported on the left limb, which is closer than the right to the central vertical axis in the majority of the subjects in standing, Patterns I and II relate more significantly to corresponding patterns in standing than when weight is supported on the right limb (Pattern I, walking left limb, $r_{4.5}$: 0.50; walking right limb, $r_{4.5}$: 0.26. Pattern II, walking left limb, $r_{12.13}$: 0.48; walking right limb, $r_{12.13}$: 0.25). In right and left limb support in walking there is some relationship between corresponding Patterns I ($r_{4.5}$: 0.25), but no relationship between corresponding Patterns II ($r_{12.13}$: 0.04).

The agreement in lateral location of the asymmetries used in the prediction of Patterns I and II in standing and walking occurs as follows:

Pattern I

Standing and left limb support—same side, 55%; opposite side, 28%; mixed, 17%
Standing and right limb support—same side, 55%; opposite side, 32%; mixed, 13%

Pattern II

Standing and left limb support—same side, 55%; opposite side, 31%; mixed, 14%
Standing and right limb support—same side, 54%; opposite side, 31%; mixed, 15%

RELATIONSHIP OF BILATERAL CONTOUR ASYMMETRY TO AGE, HEIGHT, WEIGHT, AND TO HANDEDNESS AND LIMB PREFERENCE

There tends to be a slightly significant relationship between the age increment of nine years in the subjects of this study and Pattern II (r: 0.25), but not between age increment and Pattern I (r: 0.15). Height and weight do not tend to be significantly related to either of these patterns.

There tends to be a marked relationship between handedness and the degree of horizontal asymmetry at the level of the seventh cervical vertebra (r_{bis}: 0.54), and a slightly significant relationship between handedness and horizontal asymmetry at the level of the shoulders (r_{bis}: 0.33). No relationship tends to occur, however, between handedness and the degree of asymmetry in shoulder height.

The relationship between horizontal asymmetry of the distal femora and limb preference in initiating the walk from stance tends to be slightly significant (r_{bis}: .34). In the majority of the subjects of this study the limb preferred in initiating the walk was the limb farther from the central vertical axis in the standing position.

Conclusions

Conclusions from this study are drawn as follows:

1. In standing and in walking, reliability of asymmetry tends to be greatest at the level of the upper sacrum, decreasing in degree upward and downward from this level. In general, reliability of asymmetry in walking, in comparison with that in standing, tends to be greater above the level of the upper sacrum

but less below it. In alternate limb support in walking, reliability tends to be greater when body weight is supported by the limb which is closer to the central vertical axis in standing. The exceptions to these tendencies occur at the head, shoulders, seventh cervical vertebra level, knees, and feet in the three positions studied.

2. At least four independent patterns are necessary to describe bilateral contour asymmetry in the standing position; three to describe asymmetry in left and in right limb support in walking. Two of the patterns in walking show complete correspondence to two in standing, both in their asymmetries and in their movement factors. A third pattern in walking involves the knee and foot, as it does in standing, but the pattern in walking is found in the swinging limb only and its movement factor is different from that of the pattern in standing. The fourth pattern occurs only in standing.

Each pattern is produced by an independent factor of movement occurring primarily in one of the cardinal planes. In all patterns, as the radius of movement producing each pattern increases, movement in other planes tends to influence the asymmetries and their relationship to the movement factor of the pattern tends to decrease.

3. In standing and walking, significant relationship tends to occur between the two corresponding patterns whose asymmetries and movement factors are in complete agreement. This relationship tends to be marked when body weight is supported on the limb in walking which is closer to the central vertical axis in standing. In walking, the relationship between corresponding patterns in alternate limb support tends to be significant in one pattern only.

4. An age increment of nine years in the subjects of this study tends to be related to the degree of asymmetry in one pattern only.

5. Height and weight are not significantly related to patterns of bilateral contour asymmetry in the subjects of this study.

6. Handedness tends to be related in significant degree only to horizontal asymmetry in the position of the head and cervical spine. It is not related to asymmetry in shoulder height.

7. The limb which is farther from the central vertical axis in standing tends to be preferred by the subjects of this study for the first swinging movement in initiating the walk.

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A Job Analysis of Selected Public School Physical Education Directors[1]

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JOB ANALYSIS, the process of determining and reporting upon the pertinent information relating to the nature of specific jobs, is not new. As far back as 1619, a committee within the Virginia Colony of London was appointed to describe the duties of the several officers of the company (15). However, job analysis as we know it today is largely a development of recent decades.

The technique of job analysis has been borrowed from the industrial world by many of the professions and since the field of education has experienced some satisfying results, job analysis as a method of research has long been recognized in this field. Various studies in education of a job analysis nature have made significant contributions with respect to certain aspects of the field (2, 3, 8, 9, 12, 14, 16). Similarly, studies concerning the duties of physical educators have been found to be useful in solving certain problems (1, 5, 6, 7, 10, 11, 13).

Purpose of the Study

It was the purpose of this investigation to make available the following information:

1. To provide a master list of duties performed by the public school physical education director and evaluated by selected practitioners in the field; thereby providing data for use in the re-evaluation of the physical education curricula on both the undergraduate and graduate levels.
2. To provide a check list whereby persons in the field might compare their work with others in the same work, thus expanding their knowledge and interests, and improving their practices.
3. To provide a list of duties which might be useful to persons desiring to enter the field of physical education.
4. To determine more accurately some of the current trends in public school physical education.
5. To develop standards which might be used to evaluate the duties of public school physical education directors.

Method of Procedure

The initial step in the study was the development of a valid list of duties of the public school physical education director. The following techniques were employed in collecting the duties:

[1] Abstract of a doctoral dissertation completed at Boston University School of Education, June 1951.

1. Documentary analysis
2. Personal logs and diaries
3. Introspection
4. Interviews with persons in the field.

All of the duties collected in the above ways were placed on 4 x 6 inch filing cards for sorting and classification. After duplications were eliminated, it was found that the above sources had yielded 432 duties which might be performed by the public school physical education director. The next step was to place the duties in classifications and to delimit the list by combining, recombining, condensing, and telescoping.

The duties were placed in seven classifications as follows:

1. Administrative duties
2. Duties pertaining to facilities, equipment, and supplies
3. Duties pertaining to instruction
4. Duties pertaining to special services and activities
   a. Health and safety
   b. Interscholastic athletics
   c. Extra-curricular activities
5. Supervisory duties
6. Duties pertaining to community activities
7. Duties pertaining to personal professional growth and professional contributions.

Although no claims were made as to the perfection of classification, the duties seemed to fit into most of the various categories listed above. In some instances certain duties seemed to fit equally well into more than one category and a certain amount of overlapping also seemed unavoidable.

In development of the master list of duties these criteria were devised:

1. The master list should be short enough to have practical value and yet long enough to include the pertinent duties.
2. The duties should reflect the many areas of position under investigation.
3. The list of duties should be sufficiently specific so as to be applicable to public school physical education directors in various sized communities and under varying conditions.

After combining, recombining, condensing, and telescoping under the seven classifications there evolved a list of 135 duties which was considered as the preliminary master list of duties.

The next step was the development of the preliminary master list into a tentative rating scale to be used in a try-out study. This was begun with the idea in mind that once the duties are determined, they may be developed into a suitable instrument and provide an objective method of utilizing judgments, thereby discovering the most significant duties. In view of this fact it seemed imperative to establish criteria for rating which would best meet the purpose of the study. Since the primary purpose of the study was to provide data for use for curricular purposes, FREQUENCY of performance, DIFFICULTY, and IMPORTANCE seemed to be the criteria best adapted to the purpose of the study.

Each criterion had five possible ratings and each point on the rating scale was given a description for the purpose of facilitating the ratings. The tentative

rating scale so devised was used in a try-out study by selecting 37 public school physical education directors at random. The purposes of the try-out study may be enumerated as follows:

1. To determine whether the duties had been stated in an understandable manner
2. To determine the advisability of the various classifications of the duties
3. To make additions or deletions with regard to the preliminary master list of duties
4. To determine the reliability of the ratings
5. To secure suggestions pertaining to any desirable or undesirable features of the rating scale.

As a means of determining the reliability of the ratings, the participants in the try-out study were asked to rate the duties a second time. Sixteen persons complied with this request and, on the basis of the total scores for the first and second rating scales, the reliability of the first and second ratings were determined by computing the coefficient of correlation by the Pearson product-moment method. The coefficient of correlation between the first and second ratings was $.858 \pm .04$.

With the fulfilment of the purposes of the try-out study, the final revision of the master list and rating scale was undertaken. The final revision of the master list resulted in a list of 127 duties, as follows:

I. ADMINISTRATIVE DUTIES

1. Attend to office routine necessary to performance of duties including correspondence and clerical duties
2. Keep office hours for conferences or other activities
3. Prepare notices and announcements
4. Serve on numerous miscellaneous committees which concern school policies
5. Develop plan for budgeting and accounting
6. Coordinate program with other departments
7. Have conferences with and make reports to superiors
8. Interview prospective staff members
9. Interview salesmen or other commercial people
10. Conduct staff meetings
11. Develop plan for adjusting load and transfer of teachers
12. Work with curriculum consultants in analysis or development of curriculum
13. Organize and work with teacher groups in curriculum revision
14. Develop curriculum materials
15. Develop courses of study or syllabi
16. Organize classes
17. Prepare schedule for classes
18. Make class adjustments
19. Classify pupils
20. Excuse pupils from participation
21. Discipline pupils
22. Develop plan for determining pupils' marks
23. Orient new teachers in the school system
24. Orient new teachers in the community (assist in finding home, advise on leisure time etc.)
25. Develop program for evaluation (testing program, evaluating committees, or other)
26. Operate visual aids machine

II. DUTIES PERTAINING TO FACILITIES, EQUIPMENT, AND SUPPLIES

27. Participate in planning of new facilities
28. Evaluate facilities, equipment and supplies, including inspection for safety hazards and cleanliness
29. Evaluate and select all types of instructional materials including audio-visual aids
30. Supervise sanitary conditions of physical education and athletic facilities

31. Supervise sanitary conditions of buildings including lunch rooms, rest rooms etc.
32. Develop plan for purchase of equipment and supplies
33. Provide plan for inventory of equipment including cleaning, storage, and identification such as stenciling
34. Provide plan for issue and return of equipment and supplies used by pupils
35. Develop plan for distribution of equipment, supplies, and all types of instructional materials
36. Prepare directions on care and use of equipment
37. Provide plan for repair of facilities and equipment
38. Develop plan for construction of home made equipment
39. Develop plan for preparing various types of visual aids

III. DUTIES PERTAINING TO INSTRUCTION

40. Teach regular physical education classes
41. Teach corrective classes in physical education
42. Teach related subjects such as health or safety
43. Teach classes in other subjects
44. Teach in adult education program
45. Substitute for teachers who are absent
46. Teach college courses on part time basis
47. Act as critic teacher for college or university student teachers

IV. DUTIES PERTAINING TO SPECIAL SERVICES AND ACTIVITIES

A. Health and Safety

48. Participate in physical examinations
49. Serve on health council
50. Act as health co-ordinator
51. Participate in driver education program
52. Participate in school safety program by keeping records of accidents, serving on safety council or other
53. Act as safety co-ordinator
54. Administer first aid
55. Counsel pupils on problems and make referrals when necessary to proper persons

B. Interscholastic Athletics

56. Coach interscholastic teams
57. Arrange for excuses for athletes for game participation
58. Check eligibility of athletes
59. Develop plan for classification of athletes
60. Prepare budget and receipt of expenditures of athletic teams
61. Handle ticket sales and gate receipts for athletic teams
62. Schedule contests for athletic teams
63. Prepare contracts for athletic contests
64. Arrange for transportation for athletic teams
65. Make preparations for interscholastic contests including preparation of facilities, advertising, etc.
66. Serve on athletic committee
67. Scout interscholastic contests
68. Prepare list of approved officials

C. Extracurricular Activities

69. Direct special events such as play days, demonstrations, exhibits, parades, etc.
70. Provide for modified program for handicapped
71. Attend school camps and assist with programs
72. Conduct field trips
73. Chaperone school affairs
74. Act as a sponsor for student organizations
75. Provide a plan for the development of student leaders
76. Establish an award system
77. Supervise or conduct co-recreational program
78. Supervise or conduct intramural program

V. SUPERVISORY DUTIES

79. Provide a plan for development of philosophy and objectives with teachers
80. Interpret phases of program for teachers, such as course of study, test data, etc.
81. Read and comment on teachers' lesson plans
82. Prepare bulletins for teachers
83. Develop standards for use of others to supervise instruction
84. Provide specialized resources upon which teachers may draw for meeting needs
85. Rate teachers with a rating scale
86. Assist teachers in the development of skills and the use of all types of instructional materials including audio-visual aids
87. Develop plan for self-analysis of teachers such as check list for teacher self-evaluation
88. Provide for intervisitation of teachers
89. Do demonstration teaching
90. Work with teachers to help them do demonstration teaching
91. Hold conferences with teachers
92. Visit teachers in teaching situation
93. Advise with teacher training institutions regarding pre-service training
94. Participate in planning of workshops or physical education clinics
95. Participate in planning teachers' institutes
96. Promote professional growth of teachers by encouraging them to participate in professional organizations, attend school, etc.

VI. DUTIES PERTAINING TO COMMUNITY ACTIVITIES

97. Direct community playgrounds (year around)
98. Direct community playgrounds (summer only)
99. Make home visits
100. Address numerous community organizations
101. Conduct recreation programs for community groups
102. Cooperate in programs of youth organizations (YMCA, CYO, Boy Scouts, etc.)
103. Render voluntary community services such as cooperating in drives for various funds
104. Coordinate recreation for various community agencies
105. Promote joint school and community organizations such as booster clubs
106. Conduct physical education or recreation programs sponsored by commercial organizations such as newspapers, radio, industry, etc.
107. Attend numerous miscellaneous community civic meetings
108. Assist with community surveys
109. Serve on community health agency
110. Develop plan for participation of community professional people in school program i.e. physicians and dentists
111. Provide plan for public relations for your department

VII. DUTIES PERTAINING TO PERSONAL PROFESSIONAL GROWTH AND PROFESSIONAL CONTRIBUTIONS

112. Write for professional journals or magazines
113. Write or collaborate in writing textbooks
114. Edit materials for publication
115. Do research
116. Report upon progress made in centers of research
117. Work with others in research such as filling out questionnaires, etc.
118. Do advanced study at college or university
119. Do independent study for professional growth
120. Attend meetings of professional organizations
121. Hold office in professional organizations
122. Attend professional conventions, clinics, etc.
123. Serve on national committees
124. Serve on state committees
125. Prepare exhibits for conventions

126. Keep diary or log of your own activities
127. Rate yourself on a rating scale

After the above final master list of duties was compiled, it was submitted to 380 public school physical education directors throughout the United States. These directors had been recommended by the officials of 47 State Departments of Education and/or Health who were responsible for the administration of the public school physical education program in their state. The directors selected were considered by their State Departments as men who were the most outstanding in the state and who had maintained a highly professional attitude toward their work. In addition to rating the duties for FREQUENCY, DIFFICULTY, and IMPORTANCE, the participants were asked to give the approximate percentage of their total time spent on each of the broad classifications of the duties.

Of the 380 public school physical education directors recommended for participation in the study, 305 or slightly over 80 per cent returned their ratings. Two hundred ninety, or approximately 76 per cent, of the rating scales were deemed usable for the study.

The 290 public school physical education directors were separated into the following six categories with regard to size of community and grade level of pupils coming under direction:

Category 1. Public school physical education directors of large communities (over 50,000) with elementary and secondary school grades coming under direction. There were 78 directors in this category.

Category 2. Public school physical education directors of medium sized communities (15,000 to 50,000) with elementary and secondary school grades coming under direction. There were 63 directors in this category.

Category 3. Public school physical education directors of small communities (under 15,000) with elementary and secondary school grades coming under direction. There were 35 directors in this category.

Category 4. Public school physical education directors of large communities (over 50,000) with secondary school grades only coming under direction. (32 directors in this category.)

Category 5. Public school physical education directors of medium sized communities (15,000 to 50,000) with secondary school grades only coming under direction. There were 40 directors in this category.

Category 6. Public school physical education directors of small communities (under 15,000) with secondary school grades only coming under direction. (42 directors in this category.)

Presentation of the Data

It will be recalled that each of the duties was rated on the basis of the three criteria, FREQUENCY, DIFFICULTY, and IMPORTANCE and that each criterion for rating had five possible ratings. On this basis total scores were computed for each criterion in each of the six categories of public school physical education directors. The total scores were placed in descending rank order for each criterion within each category. These scores were then transmuted into deciles for the purpose of facilitating the comparison of the criteria.

For the purpose of this study, a decile was considered as "the range of scores covered by any single division of a serially ordered group which has been divided into ten equal parts" (4). Therefore, decile 10 is the range of duties included in the highest 10 per cent of the total number of duties. Decile points were considered to be "the points marking off one decile group from another"

(4). The decile points were determined by counting down one-tenth of the duties treating each criterion in each category separately. In each instance the number of duties included within each decile were given the same decile rating.

These data are presented in Table 1, showing the decile ratings of duties for each of the six categories of public school physical education directors. The number of the duty refers to the number on the master list. The columns with the heading of "F" indicate FREQUENCY; the columns with the heading of "D" indicate DIFFICULTY, and the columns with the heading of "I" indicate IMPORTANCE.

For example, duty number one "Attend to office routine necessary to performance of duties including correspondence and clerical duties" has a decile rating of 10 for frequency, a decile rating of 5 for difficulty and of 10 for importance for Category 1 of public school physical education directors.

In order to get as complete a picture as possible of the job of the public school physical education director, it was necessary to obtain an estimate of the time spent on various phases of the job. Since it would have been next to impossible for the participants to estimate the approximate amount of total time spent on each duty, they were asked to give the approximate percentage of total time spent in the various broad classifications of the duties.

These data are presented in Table 2 and the figures represent the mean percentages of approximate time spent by the directors in each of the six categories. The figures on the last line represent the approximate number of hours per week spent on the job.

An interesting feature with regard to the data presented in Table 2 is that one may determine the approximate number of hours the director spends per week in each of the broad classifications of the duties. For example, the amount of time spent on Duties Pertaining to Instruction per week by the director in a small community with secondary school grades only coming under direction would amount to approximately 30 hours. This would be computed by taking 59 per cent of the total 52 hours per week spent on the job. Similarly, the approximate number of hours per week could be determined with respect to any of the classifications of duties in any of the categories.

Summary and Conclusions

A master list of duties performed by public school physical education directors was compiled through documentary analysis, personal logs and diaries, introspection and interview with persons in the field. The master list was developed into a rating scale using frequency of performance, difficulty, and importance as criteria for rating and submitted to outstanding public school physical education directors in the United States.

On the basis of the obtained results, it would appear that the following conclusions could be drawn from this investigation:

1. The final master list of duties might well be used for the following guidance purposes:
   (a) As a check list for persons interested in physical education as a career
   (b) As a check list for teacher training institutions for determining the needs of students on both the undergraduate and graduate levels

TABLE 1

*Decile ratings of duties for frequency, difficulty, and importance performed by public school physical education directors in all categories**

Number of Duty	Category 1			Category 2			Category 3			Category 4			Category 5			Category 6		
	F	D	I	F	D	I	F	D	I	F	D	I	F	D	I	F	D	I
1	10	5	10	10	6	9	10	7	9	10	8	9	10	7	8	10	5	7
2	10	3	8	10	5	5	8	7	5	10	4	7	9	6	5	8	3	5
3	10	2	7	10	3	3	10	2	6	10	2	5	10	2	4	10	2	6
4	10	8	8	10	4	7	8	7	5	10	7	2	8	6	2	7	7	4
5	7	7	9	5	9	8	6	10	8	5	10	7	6	10	8	4	10	10
6	9	8	9	10	10	9	9	10	10	9	9	8	9	9	8	9	9	10
7	10	2	10	10	3	9	10	5	7	9	2	8	9	4	6	9	1	5
8	6	1	10	5	1	7	3	3	6	4	1	5	3	1	5	1	1	8
9	8	1	1	8	1	1	9	2	1	7	2	1	8	1	1	9	1	1
10	10	4	10	8	5	10	6	3	7	8	7	8	6	2	7	5	2	8
11	5	9	7	2	10	6	2	10	3	1	10	7	X*	X	X	X	X	X
12	7	7	8	4	9	6	3	10	6	5	7	8	4	5	6	4	9	8
13	8	8	9	5	10	7	5	8	6	4	10	6	2	7	5	3	6	6
14	9	7	9	8	9	10	8	9	6	5	9	7	5	7	8	5	8	7
15	8	9	9	6	10	10	4	10	7	5	9	7	4	10	7	4	10	8
16	3	2	6	5	1	6	8	5	10	7	3	9	8	7	9	6	4	6
17	2	6	6	4	5	7	6	3	7	4	4	8	5	6	8	5	4	7
18	2	6	5	3	6	5	7	6	6	7	5	5	7	8	6	6	6	5
19	1	5	5	2	7	5	6	9	6	3	6	4	5	9	7	5	10	5
20	2	5	4	4	2	2	9	7	4	8	4	5	8	2	6	8	2	3
21	1	2	2	4	1	1	8	2	8	8	5	7	8	2	6	8	1	5
22	5	8	3	4	10	3	6	8	5	4	10	7	6	10	7	6	7	5
23	8	2	9	6	3	9	3	1	8	4	3	7	2	3	6	1	1	7
24	3	1	3	3	2	9	3	2	9	1	3	3	1	8	7	X	X	X
25	6	10	7	5	10	8	5	10	6	6	10	6	4	10	6	3	8	5
26	3	1	1	3	1	1	6	1	2	6	1	1	6	1	3	7	1	3
27	9	10	10	9	9	10	9	7	10	8	8	10	7	9	9	6	8	10
28	10	8	10	10	8	10	9	7	9	9	5	10	9	7	10	10	5	10
29	8	6	8	6	7	8	7	4	8	8	8	9	7	9	7	7	9	7
30	10	6	10	10	8	10	10	9	10	10	8	10	10	9	10	10	7	10
31	3	4	9	2	1	9	3	2	9	3	4	7	2	6	6	2	3	8
32	9	4	9	9	7	9	9	8	10	7	9	8	5	6	9	7	8	9
33	7	3	8	9	7	6	9	8	10	9	8	9	9	9	9	8	7	10
34	4	3	7	7	6	7	9	9	10	8	6	8	10	8	10	9	4	9
35	7	4	8	8	3	6	8	4	6	7	6	7	8	3	8	7	4	7
36	7	2	5	8	7	6	7	3	9	8	6	9	9	4	8	8	4	8
37	7	3	6	8	4	6	8	4	7	9	9	8	9	7	8	7	8	10
38	3	7	1	3	6	1	6	5	6	2	8	1	4	2	1	4	10	6
39	3	6	1	3	2	1	5	2	2	3	6	3	5	6	1	3	8	3
40	2	4	10	6	4	10	10	4	10	10	4	10	10	5	10	10	7	10
41	1	6	5	1	9	6	3	8	10	3	6	8	4	9	10	4	10	9
42	2	4	8	3	5	7	8	6	10	7	3	9	7	7	8	9	9	8
43	X	X	X	X	X	X	2	8	1	2	8	1	1	9	1	4	9	1
44	1	5	2	1	3	3	1	1	1	2	1	2	1	1	1	1	6	1
45	X	X	X	1	2	1	2	2	1	4	3	1	1	1	2	2	3	1
46	2	3	2	1	6	1	X	X	X	1	1	1	X	X	X	X	X	X
47	4	1	5	3	4	5	1	8	6	5	2	8	5	4	5	3	3	7
48	4	1	5	5	7	5	6	3	8	5	5	8	6	3	9	6	3	9
49	7	2	9	6	4	8	6	8	6	5	6	5	5	2	4	3	2	4
50	8	7	8	6	4	8	6	10	6	2	7	4	4	8	3	3	8	4
51	3	2	4	1	5	4	1	6	8	X	X	X	X	X	X	X	X	X
52	7	4	7	4	2	4	4	3	4	4	8	3	3	8	8	1	7	2
53	6	4	7	2	3	4	3	6	3	1	7	2	X	X	X	X	X	X
54	2	1	6	7	1	6	10	1	9	10	1	10	10	3	10	10	2	10

* Whenever an "X" occurs in the table it signifies that the duty was not performed in that category.

TABLE 1—*Continued*

Number of Duty	Category 1			Category 2			Category 3			Category 4			Category 5			Category 6		
	F	D	I	F	D	I	F	D	I	F	D	I	F	D	I	F	D	I
55	3	7	6	7	3	7	9	6	8	10	4	9	9	5	9	9	9	9
56	1	3	5	6	8	6	10	5	9	9	10	8	10	9	10	10	8	9
57	1	1	2	6	1	3	5	3	3	10	3	6	10	2	6	9	1	3
58	3	2	6	7	2	10	10	1	8	9	2	9	9	1	10	10	2	8
59	2	3	4	5	5	3	5	3	4	6	5	6	7	8	7	5	4	4
60	4	8	6	6	9	8	7	10	9	7	8	10	7	9	9	7	8	8
61	2	6	3	3	8	4	3	6	7	4	10	10	3	5	10	1	5	2
62	6	9	7	9	8	8	10	8	8	9	9	10	10	10	10	10	10	9
63	2	5	3	6	1	4	9	3	8	9	5	9	8	3	9	8	2	6
64	2	2	8	9	4	7	10	9	10	10	7	10	10	3	10	10	5	8
65	5	5	7	8	4	7	10	9	7	9	8	10	9	7	8	9	10	9
66	9	4	8	9	2	10	9	3	7	9	3	9	9	3	8	9	2	5
67	1	1	1	2	5	1	7	4	2	6	6	3	6	4	4	8	8	4
68	4	7	4	7	4	7	8	4	7	7	4	6	8	4	8	7	9	3
69	7	8	5	7	9	6	7	8	3	5	9	4	5	10	5	4	10	4
70	5	9	8	4	10	10	3	9	9	3	9	7	4	10	9	2	10	8
71	1	8	3	1	6	3	1	4	1	1	5	2	1	4	3	1	6	2
72	1	7	1	1	6	1	2	7	2	1	5	2	1	5	2	2	7	1
73	1	1	1	4	1	1	7	2	2	7	3	2	6	2	3	6	1	1
74	1	10	2	3	9	2	7	8	2	8	9	6	7	8	3	8	3	2
75	5	4	7	5	9	7	7	9	7	7	9	9	7	5	7	7	7	7
76	5	5	2	7	7	3	8	4	5	6	7	3	8	8	5	5	4	3
77	5	6	6	7	8	6	8	9	6	7	10	8	6	5	5	5	6	6
78	8	5	10	10	7	10	10	6	10	10	9	10	10	4	9	9	3	10
79	9	10	10	7	10	10	5	9	10	5	7	7	4	9	7	X	X	X
80	10	8	10	9	7	8	5	8	8	5	6	5	3	5	8	X	X	X
81	6	5	4	4	6	2	2	6	1	3	2	4	X	X	X	X	X	X
82	10	3	6	8	2	3	4	4	3	5	3	4	2	1	2	X	X	X
83	7	9	6	4	8	3	3	4	2	3	6	5	X	X	X	X	X	X
84	8	9	7	7	7	7	3	7	6	3	4	8	1	4	5	X	X	X
85	4	10	1	1	6	1	1	6	1	2	10	3	X	X	X	X	X	X
86	8	8	8	8	8	8	5	7	8	6	5	6	3	5	5	X	X	X
87	4	9	3	1	8	3	1	10	4	2	10	4	X	X	X	X	X	X
88	6	7	4	2	3	3	1	5	2	2	6	6	X	X	X	X	X	X
89	6	1	3	8	4	6	5	6	4	6	3	4	3	3	2	X	X	X
90	7	3	4	5	4	5	2	6	3	4	5	4	X	X	X	X	X	X
91	10	3	9	9	5	8	6	4	5	8	1	7	4	4	4	X	X	X
92	10	3	10	10	3	8	5	2	8	6	6	7	3	2	7	X	X	X
93	5	5	6	3	5	4	2	4	3	4	6	6	2	2	5	1	3	6
94	7	5	7	4	8	5	4	8	3	5	7	6	4	7	2	3	7	7
95	6	3	6	2	7	4	1	9	2	2	5	2	X	X	X	X	X	X
96	9	10	10	7	8	9	4	7	8	6	7	7	4	6	4	3	6	4
97	3	9	7	2	5	8	1	10	9	1	6	9	2	10	7	1	3	6
98	4	10	8	5	6	9	5	3	7	2	5	3	6	6	8	7	9	8
99	1	7	2	2	4	5	4	7	8	3	4	2	2	3	3	4	5	4
100	9	5	5	8	5	7	7	5	5	6	2	3	6	5	4	6	5	4
101	3	6	2	6	4	4	4	4	5	1	4	2	5	8	3	3	5	2
102	8	4	5	8	2	4	6	3	4	6	2	5	7	6	4	5	2	6
103	7	7	3	8	5	2	7	5	2	8	3	3	5	6	2	5	7	2
104	4	8	4	5	6	5	4	6	4	1	8	2	3	6	2	2	5	4
105	2	4	1	4	6	2	4	5	2	2	9	4	2	2	1	2	8	2
106	1	9	1	1	3	1	2	4	1	1	2	1	2	4	1	1	4	2
107	9	5	3	10	6	3	9	4	5	8	3	4	7	3	2	7	5	3
108	5	4	2	5	8	2	4	6	2	3	5	3	2	4	1	2	6	2
109	6	3	4	3	3	4	3	3	5	1	2	5	1	1	4	1	1	3
110	6	10	7	4	9	8	3	9	9	3	7	8	3	9	7	1	10	9

TABLE 1—*Concluded*

Number of Duty	Category 1			Category 2			Category 3			Category 4			Category 5			Category 6		
	F	D	I	F	D	I	F	D	I	F	D	I	F	D	I	F	D	I
111	6	9	9	9	10	9	7	9	9	9	8	6	8	7	7	6	9	9
112	5	10	3	2	9	2	2	8	3	3	10	1	3	8	2	1	8	2
113	1	10	4	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
114	4	6	3	2	10	2	1	7	2	1	7	3	1	7	3	X	X	X
115	5	10	4	3	9	4	2	10	5	4	10	2	4	10	4	2	9	4
116	2	7	3	1	9	2	1	7	4	2	5	3	X	X	X	X	X	X
117	9	8	5	7	10	5	7	8	6	8	4	4	7	8	4	6	6	4
118	6	9	6	6	9	8	5	7	6	8	7	6	6	10	6	5	10	7
119	9	6	9	9	7	9	8	5	9	10	4	10	8	6	9	8	8	10
120	9	4	9	10	3	9	9	7	7	10	3	9	9	8	6	8	2	7
121	8	5	4	7	5	5	5	2	3	7	5	2	7	6	2	4	4	4
122	9	6	8	9	2	7	8	7	7	9	6	5	8	7	4	6	7	6
123	5	9	4	1	8	2	X	X	X	1	8	2	X	X	X	X	X	X
124	8	7	6	6	6	4	4	7	4	7	3	5	6	5	2	2	7	3
125	4	10	1	2	6	1	1	10	1	2	8	1	X	X	X	X	X	X
126	6	6	2	5	8	2	4	5	3	4	6	1	5	4	2	2	3	3
127	3	9	5	2	10	5	2	10	3	5	8	3	2	7	3	1	5	7

TABLE 2

Mean percentages of time spent in the broad classifications of the duties by public school physical education directors in all categories

Classification of Duties	Category 1	Category 2	Category 3	Category 4	Category 5	Category 6
Administrative duties	30	22	14	14	13	8
Duties pertaining to facilities, equipment and supplies	10	10	9	9	9	8
Duties pertaining to instruction	7	23	42	39	45	59
Duties pertaining to special services and activities	11	12	13	16	16	15
Supervisory duties	28	20	10	11	7	2
Duties pertaining to community activities	8	7	6	5	5	5
Duties pertaining to personal professional growth and professional contributions	6	6	6	6	5	3
Average number of hours per week spent on the job	52	52	53	51	53	52

(c) As a self-analysis check list for those in the field to expand their knowledge and interests and improve their practices

2. Those public school physical education directors with all grades under direction have the greatest number of supervisory duties. FREQUENCY of performance of supervisory duties becomes less as size of community becomes smaller, but their DIFFICULTY and IMPORTANCE remain constant.

3. In the three categories of public school physical education directors with all grades under direction the duty "Provide a plan for development of philosophy and objectives with teachers" constantly rated high. This might imply that this duty is more of a problem with elementary classroom teachers since it did not prevail in any of those categories with secondary grades only under direc-

tion, even in large communities. This would perhaps indicate the need for more training in physical education for persons preparing to teach in the elementary school.

4. The frequency of performance of a duty will not always signify its importance. This is brought out by the fact that a number of duties had a low decile rating for frequency and a high decile rating for importance.

5. Any person who aspires to become a public school physical education director can expect to spend over 50 hours per week on the job.

6. With regard to time spent on the job, all directors regardless of community size or grade level of pupils under direction, spend approximately the same percentage of time on duties pertaining to facilities, equipment, and supplies. The amount of time varies with the category of directors in the other types of duties with the greatest variation occurring in administrative duties, duties pertaining to instruction, and supervisory duties.

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A Nation-wide Survey Analysis of Major Administrative Problems in Required College Physical Education Programs

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THERE SEEMS to be a group of problems related to the administration of required physical education programs which are rather generally encountered in colleges and universities throughout the country. The study reported here was undertaken in an effort to discover how these problems are solved in a reasonably large sampling of colleges and universities, in the hope that the information gained might furnish guidance to schools interested in re-evaluating or reorganizing their required programs. It was also hoped that the results might furnish a certain insight into the qualitative status of existing administrative policies.

Procedure

Questionnaires were sent to 120 selected colleges and universities. A questionnaire was sent to every state university, most state supported schools, and a variety of private institutions.

Returns

Replies to the questionnaire were received from 101 schools (84%). Of this number, 97 completed the questionnaire forms. It should be noted that some of the schools failed to respond to certain sections of the questionnaire. Furthermore, many questions were of such a nature that the respondees could select more than one answer, thus making the total frequency for these questions greater than 97.

Represented in the reply were 44 states and the District of Columbia, with a frequency of institutions per state varying from 1 to 6. Of these institutions, 41 were private and 60 were state-supported. Those states in which no institution responded to the questionnaire were: Kentucky, Rhode Island, South Dakota, and Maryland.

Results

(See tables, p. 68–70)

VARSITY ATHLETES IN THE REQUIRED PHYSICAL EDUCATION PROGRAM

Administrative procedure	Institutions responding	
	Number	Percent*
All students out for varsity athletics:		
Are excused from required classes during the respective sport seasons	54	57
Are excused from required classes during the entire semester or quarter	19	20
Attend required physical education classes	8	9
Attend required classes except on days of competition	6	6
Other procedures indicated:		
Athletes are transferred to athletics and given credit	4	4
A course number is given to athletics and athletes register for this course	3	3

ATTENDANCE REGULATIONS

1. To be valid, the excuse must originate with the:		
School health department	86	89
Dean of respective college	30	31
Family physician	11	11
Dean of men	8	8
Instructor	5	5
Parents	1	1
Others	4	4
2. When a student has excessive absences, he is contacted by the:		
Dean of college in which student is enrolled	42	43
Instructor involved	37	38
Director of required program	36	37
Dean of men	6	6
Registrar	4	4
Student is not notified	4	4
Others	2	2
3. Making up of absences:		
Students are permitted to make up classes missed	57	59
Students are *not* permitted to make up classes missed	40	41
Students are permitted to make up *only* excused absences	41	42
Students are permitted to make up all absences	16	17
4. Excessive absences:		
If the student has excessive unexcused absences his grade is affected	88	96
If the student has excessive unexcused absences his grade is *not* affected	4	4
Before the student's grade is affected, he may have the following number of absences:		
Three	33	36
Four	14	15
Two	13	14
One	10	11
None	8	9
Five	3	3
Six	1	1
Seven	1	1

CLASS ORGANIZATION

Administrative procedure	Institutions responding	
	Number	Percent*
1. Classification of students in terms of:		
Year in school (1st semester, quarter, etc.)	53	55
Physical fitness tests	21	22
No method of classification	14	14
Athletic ability tests	8	8
Swimming test	5	5
Interest and schedule	2	2
Height and weight	0	0
2. Prerequisites of elective courses:		
Students are required to take certain prerequisites before they can enroll in elective classes	53	62
Students are *not* required to take certain prerequisites before they can enroll in elective classes	32	38
3. Specific prerequisites required:		
Aquatics, (e.g. swimming)	47	55
Team sports, (e.g. basketball)	28	33
Self-testing activities, (e.g. tumbling)	19	22
Recreational activities, (e.g. badminton)	17	20
Combatives, (e.g. wrestling)	17	20
Basic course	7	8
Others	5	6
4. Repeating Courses:		
Students are *not* permitted to elect popular activities more than once for credit	50	56
Students are permitted to elect popular activities more than once for credit	39	44
5. Rainy Day Program:		
Indoor space and facilities are used for practicing the out-door activity	71	73
Rules, strategy, techniques, etc., are discussed in available classrooms	53	55
Some other activity is substituted for the regular activity	29	30
Movies are shown	9	9
Class is dismissed	1	1
Others	2	2

* Percentages are given to the nearest whole number.

PROGRAM OFFERINGS

1. Major emphasis in programs:		
Carry-over skills	78	80
Conditioning	31	32
Vigorous athletic sports	28	29
No particular emphasis	1	1
Other	8	8
2. Specific Carry-over Sport Offerings:		
Volleyball	86	89
Swimming	84	87
Tennis	84	87
Badminton	74	76
Golf	73	75

PROGRAM OFFERINGS—*Continued*

Administrative procedure	Institutions responding	
	Number	Percent*
Bowling	43	44
Archery	40	41
Dancing (social)	37	38
Handball	34	35
Fly and bait casting	21	22
Gymnastics	11	11
Fencing	7	7

Others mentioned (not in order of frequency) include: Back-yard sports, basketball, boxing, camping, circus stunts, fly tieing, folk dancing, hiking, horseshoes, ice skating, individual conditioning, life saving, recreational games, riding, rifle and pistol shooting, roller skating, rope climbing, sailing, shuffleboard, skiing, square dancing, squash, soccer, softball, speedball, table tennis, touch football, weight lifting, and wrestling.

GRADING COMPONENTS

	Number	Percent
Skill tests	70	72
Written examinations	50	52
Test of physical conditioning and/or ability	45	46
Term reports	10	10

PURCHASE OF EQUIPMENT

	School		Student	
	Number	Percent	Number	Percent
Shoes	2	2	85	88
Uniform, excluding shoes	17	17	75	77
Recreational equipment (tennis rackets, etc.)	51	53	42	43
Towels	73	75	21	22
Locks	77	79	11	11
Other equipment (basketballs, bats, etc.)	88	91	1	1

FEES

	Number	Percent
A fee is *not* charged students enrolling in physical education	47	52
A fee is charged all students enrolling in physical education	43	48

Fee size ranged from $1.00 per semester to $27.00 per year. High fees were charged in instances of special course offerings, e.g., skiing or mountain climbing; in some instances this fee included required athletic event tickets.

The majority of fees were from $1.00 to $3.00 per term.

Summary

A national survery was made to determine the current administrative policies related to required physical education programs in colleges and universities. Of the 120 questionnaires sent out, 101 were returned.

In a number of instances, the survey results suggest a need for extensive critical evaluation and, perhaps, the establishment of policies which will reflect "best professional thinking."

1. The majority of schools excuse their varsity athletes from the required physical education program at least during their sport seasons.
2. The school health department, the Dean of the student's college, and the student's instructor are most frequently individuals involved in validating excuses and notifying the student of excessive absences.
3. Excessive absences (usually 3) affect students' grades.
4. Students are most frequently classified for participation on the basis of the year or semester enrolled. Only 34 schools, or 35% of the schools studied use tests as a method of grouping.
5. Students are usually required to take prerequisites (most frequently aquatics) before they can elect activities.
6. Major emphasis in most programs is on carry-over skills. There is, however, no unanimity of opinion as to just which skills are "carry-over."
7. Grading is most frequently based on ability to perform skills.
8. The school usually furnishes the towels, locks, and major equipment; the student furnishes his uniform and shoes. Although the majority of schools furnish recreational equipment, such as badminton or tennis rackets, many do require the students to purchase this equipment.
9. Fees are charged in about half of the schools (48%). This fee usually ranges from $1.00 to $3.00 per term.

Sociometric Status and Athletic Ability of Junior High School Boys

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It is generally recognized that the ability of the individual to attain status among his peers is extremely important in his total personality development. In addition the success of one's educational endeavors is conditioned by his acceptance or lack of acceptance in the social group. Physical educators for many decades have vigorously postulated that directed participation in big-muscle activities provides an excellent medium through which social acceptability may be achieved. Although there have been many allegations regarding such participation, there seems to be little objective evidence indicating the degree to which physical education experiences aid in the attainment of status in the group.

Since the innovation of the sociometric test by Moreno (9), there have been many studies of the social interaction in both school and non-school environments and the extent to which individuals gain or fail to gain status in the group. There seem to be reported both substantiating and conflicting results regarding the factors that are important in determining social acceptability. Among those factors that have been found to be related to one's status in the group are I. Q., M. A., C. A., physical maturity, group membership, school grade, socioeconomic background, and certain personality traits (4, 10).

Several investigations have been focused on situations in physical education. However, most of these have been rather specific in nature in that they have been concerned with such problems as the relationship between sociometric status and skill in specific activities such as volleyball, swimming, and dancing (1, 5, 13) or the ability to learn a particular motor skill such as tracing with a stylus (6). It would seem that there is a need not only for many more such specific studies but also for an investigation of the relationship between sociometric status and all-round ability in physical education activities.

The purpose of this study therefore has been to investigate the relationship between sociometric status and general athletic ability among junior high school boys and the extent to which this relationship compares with that between sociometric status and mental maturity. It is hoped that the study may have some value in providing additional information regarding the reasons for acceptance or rejection of the individual in the school group.

Subjects

The subjects consisted of 438 junior high school boys in the University High School, Austin, Texas. The study was conducted in the regular physical education classes during the Spring Semester, 1950–51. The distribution of the 438 boys with regard to grades and classes is as follows: 135 in the 7th grade in three classes of 40, 45, and 50; 156 in the 8th grade in three classes of 48, 50, and 58; and 147 in the 9th grade in four classes of 32, 38, 38, and 39.

Tests

SOCIOMETRIC STATUS

In the sociometric test each student was asked to name the three boys he likes best in his own class, the three in his own grade, and the three in the entire school. Three separate status scores were obtained on each individual, namely one for his status in class, one for his status in grade, and one for his status in the entire school. Equal weights were given to first, second, and third choices in the computation of the status scores.

On the basis of these status scores the stars, neglectees, and a middle group were identified for each class, for each grade, and for the entire school. These three sociometric status groups were determined on the basis of the limits that were presented by Bronfenbrenner (2) in his computation of the probability of selection. By this method the stars are those individuals who received a larger number of choices than would have been expected by chance at the two per cent level of confidence while the neglectees are those who received a smaller number than would have been expected at the two per cent level. The middle group are those individuals who are neither stars nor neglectees.

GENERAL ATHLETIC ABILITY

Three criteria were used to indicate general athletic ability, namely an athletic index, judgment ratings by fellow students, and interschool and intramural athletic experience. A brief description of the methods of obtaining the data for these criteria follows:

(1). *Athletic index.* The test items in the athletic index are the 50-yard dash, the standing broad jump, and the softball throw for distance. These tests were administered in the usual manner with the 50-yard dash being measured to the nearest one-tenth of a second, the standing broad jump to the nearest inch and the softball throw for distance to the nearest foot. Two trials were allowed in the 50-yard dash with three trials in each of the other two tests. The best scores of these trials were recorded. The index scores consist of the average of the T-scores on the individual items.

(2). *Judgment ratings.* In the judgment ratings of athletic ability, each student was asked to name the three boys whom he considers to be the best all-round athletes in his own class, the three in his own grade, and the three in the entire school. These choices were handled in a manner similar to that for the sociometric test in that stars, neglectees, and a middle group were determined for each class, for each grade, and for the entire school.

(3). *Experience in athletics.* Two scores were obtained on each individual for experience in athletics, namely experience in interschool athletics and experience in interschool and intramural athletics combined. These scores indicate the number of sports in which the individual engaged during the school year. Four is the maximum number of sports in which a student was permitted to participate either in interschool or intramural athletics or both. These four sports are football (touch football for intramurals), basketball, softball, and track and field.

MENTAL MATURITY

Mental maturity was measured by the *New California Short-Form Test of Mental Maturity* (14). Although this test yields separate scores for language and non-language abilities and for such specific factors as memory, spatial relationships, logical reasoning, numerical reasoning, and vocabulary, only the total scores were used in this study. The total score is advocated by some authorities to be more valid than are the separate scores (3).

Findings and Interpretations

In Table 1 are presented the number and percentage of individuals in each grade who were stars, neglectees, or in the middle group on the basis of the "Best Athlete" choices and of the "Best Liked" choices. It will be noted that there are decidedly more neglectees for the "Best Athlete" than for the "Best Liked" criterion whereas the situation is reversed for the middle group. There is relatively the same number of stars for the two criteria. In addition there

TABLE 1

Number and Percentage of Individuals in Each of the Social Status and the Athletic Ability Groups

Group	Chosen as Best Athlete						Chosen as Best Liked					
	Class		Grade		School		Class		Grade		School	
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
7th Grade												
Stars	13	10	14	11	6	04	17	12	16	12	13	10
Middle group	47	35	53	39	35	26	98	73	95	70	97	72
Neglectees	75	55	68	50	94	70	20	15	24	18	25	18
8th Grade												
Stars	20	13	13	08	6	04	22	14	13	08	12	08
Middle group	41	26	40	26	39	25	104	67	115	74	116	74
Neglectees	95	61	103	66	111	71	30	19	28	18	28	18
9th Grade												
Stars	19	13	11	07	13	09	18	12	17	12	16	11
Middle group	35	24	41	28	33	22	98	67	100	68	109	74
Neglectees	93	63	95	65	101	69	31	21	30	20	22	15
Total												
Stars	52	12	38	09	25	06	57	13	46	10	41	09
Middle group	123	28	134	30	107	24	300	69	310	71	322	74
Neglectees	263	60	266	61	306	70	81	18	82	19	75	17

seems to be little difference in the percentages among the three grades for choices in class, in grade, and in the entire school.

The discussion of the purpose of this study will be based primarily on a consideration of the data presented in Tables 2 through 7. More specifically the data in the tables will be examined in order to investigate (1) the relationships among the criteria of athletic ability, (2) the relationship between sociometric status and athletic ability, and (3) the relationship between sociometric status and mental maturity.

RELATIONSHIPS AMONG CRITERIA OF ATHLETIC ABILITY

There appears to be substantial relationships among the criteria of athletic ability as evidenced by moderately high coefficients of correlation between judgment ratings and athletic experience and between judgment ratings and the athletic index scores and by very high critical ratios of the difference between the means of the athletic index among stars, neglectees, and the middle group determined on the basis of the choices of best athlete.

These coefficients of correlation consist of the coefficients of contingency presented in Table 2 between choice of best athlete and interschool participation and between choice of best athlete and interschool and intramural participation combined and of the rank-difference correlations shown in Table 3 be-

TABLE 2

Coefficients of Contingency Between Choice of Best Athlete and Athletic Participation and Between Choice of Best Liked and Athletic Participation

	Class				Grade				School
	7	8	9	Total	7	8	9	Total	Tota
Best athlete—interschool participation	.62	.66	.69	.64	.76	.78	.78	.69	.77
Best athlete—interschool & intramural	.66	.43	.52	.49	.64	.48	.56	.52	.52
Best liked—interschool participation	.66	.54	.54	.49	.57	.54	.60	.52	.57
Best liked—interschool & intramural	.69	.37	.47	.45	.57	.35	.49	.41	.41

TABLE 3

Rank-Difference Correlations Among Social Status, Athletic Ability, and Mental Maturity Scores

	7-1	7-2	7-3	8-1	8-2	8-3	9-1	9-2	9-3	9-4
Athletic index—best athlete	.63	.71	.59	.66	.69	.72	.74	.64	.81	.72
Athletic index—best liked	.62	.37	.37	.40	.37	.52	.71	.52	.36	.65
Best athlete—best liked	.61	42	.22*	.52	.56	.63	.64	.75	.37	.78
Best liked—mental maturity	−.11*	−.04*	.25*	.10*	.22*	.05*	.07*	.06*	.07*	.05*

* Not significant at the 01 per cent level.

tween choice of best athlete and the athletic index scores. All of these coefficients are significant at the one per cent level and are sufficiently large enough to be classified as moderately high on the basis of limits presented for the interpretation of correlations (7). There seems to be little difference among the three grades with respect to these relationships.

As revealed in Table 4, the critical ratios of the difference between the means on the athletic index among the athletic ability groups (stars, neglectees, and middle group determined on the basis of choices of best athlete) are all highly significant and in each case the larger scores were made on the athletic index by the more highly chosen group. It would appear on the basis of the size of these critical ratios that there is more difference in athletic ability as measured by the athletic index scores between the stars and the middle group than between the neglectees and the middle group.

TABLE 4

Critical Ratios of the Difference Between the Means on the Athletic Index Among the Athletic Ability and the Social Status Groups

Group	Critical Ratios[1]					
	Class		Grade		School	
	AA	SS	AA	SS	AA	SS
7th Grade						
Stars—middle group	7.0	6.4	5.6	3.6	7.1	3.6
Stars—neglectees	11.4	7.1	9.0	3.6	11.3	4.1
Middle group—neglectees	6.4	2.4*	4.4	1.0†	4.4	1.8†
8th Grade						
Stars—middle group	5.1	3.9	5.2	2.7	3.2	6.2
Stars—neglectees	8.5	3.8	8.9	3.7	7.1	5.7
Middle group—neglectees	3.0	1.0†	4.1	2.2*	5.9	1.6†
9th Grade						
Stars—middle group	5.5	4.9	7.1	5.1	6.9	4.5
Stars—neglectees	11.1	6.7	13.9	6.0	14.4	4.6
Middle group—neglectees	4.9	3.4	6.9	2.6	6.6	1.7†
Total						
Stars—middle group	9.2	6.9	6.6	5.0	7.9	6.7
Stars—neglectees	14.9	7.5	10.7	6.1	14.5	7.5
Middle group—neglectees	5.1	2.5	5.0	2.8	7.1	3.1

[1] AA—Chosen as best athlete.
SS—Chosen as best liked.
* Not significant at the 01 per cent level.
† Not significant at the 05 per cent level.

Additional evidence of the relationships among the criteria of athletic ability is very high critical ratios of the difference between the means on the athletic index between interschool athletes and non-athletes. The critical ratios obtained between these two groups were 9.4 for the 7th grade, 7.9 for the 8th grade, and 9.8 for the 9th grade.

RELATIONSHIP BETWEEN SOCIOMETRIC STATUS AND ATHLETIC ABILITY

The relationship between sociometric status and athletic ability as measured in this study seems to be moderately high in almost all of the groups studied. The coefficients of contingency in Table 2 between choice of best liked and interschool participation and between choice of best liked and interschool and intramural participation combined are all significant at the one per cent level. With one exception, the rank-difference correlations between choice of best liked and choice of best athlete are also highly significant.

The individuals most highly chosen as best liked tended to make much higher scores on the athletic index as revealed by the critical ratios of the difference between the means on the athletic index among the stars, neglectees, and the middle group presented in Table 4. With few exceptions these critical ratios are significant at the one per cent level and most are well above the limits necessary for such significance. In every case the more highly chosen group has the higher mean score on the athletic index. Although differences are noted among the grades, there does not appear to be any trend with regard to any particular grade. It is readily apparent, however, that much larger ratios are obtained between the stars and the middle group than between the neglectees and the middle group.

Further analysis of the athletic ability of the sociometric stars and neglectees was made by computing the percentages of stars on the "Best Liked" criterion who were also stars on the "Best Athlete" criterion and the percentages of neglectees on the "Best Liked" criterion who were neglectees on the "Best Athlete" criterion. These percentages for the choices in class, in grade, and in the entire school are revealed in Table 7. Although there are differences in the percentages among the grades and the types of choices, it is noted that about one-half of the sociometric stars were also outstanding athletes in the opinion of their fellow students and that over three-fourths of the neglectees received no choices for athletic ability.

Additional data are presented in Table 7 with regard to the interschool and intramural athletic experience of the sociometric stars and neglectees. It is seen from these data that well over one-half of the stars had participated in at least one interschool sport whereas almost none of the neglectees had such participation. When both interschool and intramural participation are considered, almost all of the stars and about one-half of the neglectees had some athletic experience.

The results obtained in this investigation with regard to the relationship between sociometric status and athletic ability are similar to those reported in previous studies at The University of Texas. Huey (8) using 122 boys in the 7th, 8th, and 9th grades, obtained bi-serial coefficients of correlation of .41, .66, and .66 between choices of best liked and scores on an athletic index. Raven (11) in a study of 108 boys in the 6th grade obtained a bi-serial coefficient of .54 for a group of Anglo-Americans, .24 for a group of Latin-Americans, and .40 for a mixed group, whereas Shaw (12) found rank-difference correlations of .41 and .57 respectively for Anglo-American and Latin-American boys in

TABLE 5

Critical Ratios of the Difference Between the Means on the Mental Maturity Test Among the Social Status Groups

Group	Critical Ratios		
	Class	Grade	School
7th Grade			
Stars—middle group	−1.0	1.4	−0.6
Stars—neglectees	0.2	1.2	0.8
Middle group—neglectees	1.5	0.1	2.5†
8th Grade			
Stars—middle group	−2.7*	−1.1	−2.1†
Stars—neglectees	0.9	−0.3	−0.9
Middle group—neglectees	4.4*	0.9	1.0
9th Grade			
Stars—middle group	0.7	−0.1	0.2
Stars—neglectees	0.1	−0.2	0.1
Middle group—neglectees	−0.7	−0.2	−0.1
Total			
Stars—middle group	−1.8	0.0	−1.4
Stars—neglectees	0.5	0.4	0.1
Middle group—neglectees	2.9*	0.7	2.0

* Significant at the 01 per cent level.
† Significant at the 05 per cent level.

TABLE 6

Percentage of Stars and Neglectees on "Best Liked" Criterion Who Were Also Stars and Neglectees on "Best Athlete" Criterion

Group	Liked Best in Class				Liked Best in Grade				Liked Best in School			
	7	8	9	Total	7	8	9	Total	7	8	9	Total
"Best liked" stars who were also "best athlete" stars	53	57	61	57	50	38	47	46	38	42	56	46
"Best liked" neglectees who were also "best athlete" neglectees	65	83	100	85	50	89	84	76	76	93	82	84

TABLE 7

Percentage of Stars on Best Liked Criterion with Intramural and Interschool Experience and Percentage of Neglectees on Best Liked Criterion with No Intramural and Interschool Experience

Group	Liked Best in Class				Liked Best in Grade				Liked Best in School			
	7	8	9	Total	7	8	9	Total	7	8	9	Total
Interschool experience												
Stars with experience	53	57	56	55	38	62	76	59	54	75	69	66
Neglectees without experience	100	100	93	98	100	96	87	94	100	100	86	96
Interschool & intramural experience												
Stars with experience	100	90	94	95	94	92	100	96	100	83	100	95
Neglectees without experience	70	47	43	50	50	39	39	42	56	39	41	45

the 8th and 9th grades. In all of these studies sociometric status was based on choice of best liked and the athletic index was similar to the one used in this investigation.

RELATIONSHIP BETWEEN SOCIOMETRIC STATUS AND MENTAL MATURITY

There apparently is no appreciable relationship between sociometric status and mental maturity among the groups in this study. None of the rank-difference correlations in Table 3 between choice of best liked and the mental maturity test scores is significant even at the five per cent level. Of the critical ratios between the means on the mental maturity test among the stars, neglectees, and the middle group, shown in Table 5, only three are significant at the one per cent level. There seems to be no consistent pattern even among these ratios, for in two cases the more highly chosen groups achieved the larger mean scores on the mental test and in the other instance this group made the smaller scores.

Summary

The purpose of this study has been to investigate the relationship between sociometric status and general athletic ability among 438 junior high school boys and the extent to which this relationship compares with that between sociometric status and mental maturity. The study was conducted in the regular physical education classes in the seventh, eighth, and ninth grades.

Three separate sociometric status scores were obtained on each student, namely, one each for his status in his own class, in his grade, and in the entire school. The scores were based on student choices of those whom he likes best. General athletic ability was indicated by (1) scores on an athletic index consisting of the 50-yard dash, the standing broad jump, and the softball throw for distance; (2) judgment ratings by fellow students of best all-round athletes; and (3) experience in interschool and intramural athletics. Mental maturity was measured by the *New California Short-Form Test of Mental Maturity*.

Conclusions

On the basis of a statistical analysis of the data obtained in this study the following conclusions would seem to be justified:

1. There appears to be substantial relationships among the criteria of general athletic ability.
2. The relationship between sociometric status and athletic ability seems to be moderately high in almost all of the groups studied.
3. There apparently is no appreciable relationship between sociometric status and mental maturity.
4. Of the factors included in this study, athletic ability as measured by the athletic index and participation in interschool and/or intramural athletics is probably the predominant factor in conditioning choices of best liked. This held true about equally well for choices within classes, within grades, and within the whole school.
5. It is possible that the boys achieved their popularity through participation in interschool athletics more than any other factor included in this in-

vestigation. Admitting other factors conditioning selection, there appears to remain the possible implication that encouraging athletic participation by all boys will help greatly to improve social status, presumably a desirable goal of education.

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Achievement Levels in Tennis Knowledge and Skill for Women Physical Education Major Students

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AN APPARENT NEED in the field of professional preparation of physical education major students is a means for evaluating the achievements of major students in various areas of the professional curriculum. The purpose of this study was to provide a tool for the evaluation of achievement of women physical education major students in tennis.[1]

The problems involved were (a) to construct and standardize a tennis knowledge test which would meet the criteria of a good test, (b) to develop norms on the knowledge test based on the performance of a large number of women students majoring in physical education, who had completed all of their course work in tennis, including the course in Methods of Teaching Tennis, and (c) to develop norms on a test of tennis ability, based on the performance of a large number of women students majoring in physical education, who had completed their courses of instruction in tennis.

Method of Procedure

To determine achievement levels in knowledge of tennis, it was necessary to construct and standardize a tennis knowledge test. The method used to approach curricular validity of the test was the analyses of textbooks and courses of study, and the judgments of competent persons. Courses of study used were those from Butler University, Hanover College, Ohio State University, Ohio University, and Wittenberg College. Textbooks used were those by Ainsworth, *et al* (2), Browne (3), Driver (4), Kramer (8), Moss (9), and Yocum and Hunsaker (15).

Following these analyses, a table of objectives was drawn up, outlining the essentials of tennis which seemed to be commonly covered in a course in Methods of Teaching Tennis. A questionnaire was constructed and sent to instructors of the Tennis Methods course in 20 colleges and universities throughout the country. This questionnaire listed the above six books and asked that the instructors rate the books in order of preference for use in a Tennis Methods course.

The questionnaire also contained the list of objectives for a course in Methods of Teaching Tennis. Spaces were provided so that respondents could designate whether they thought each objective should or should not be included in a

[1] The material for this article is based on a disserttaion submitted in partial fulfillment of the requirements for the degree of Doctor of Physical Education at Indiana University, 1952.

knowledge test for the course, and what percentage of emphasis they believed should be assigned to each of the objectives. Additional spaces were allowed so that respondents could write in other objectives.

Thirteen questionnaires were returned, nine of which were completely and correctly filled in. Two respondents mentioned three additional objectives, of which two were covered by objectives already listed, and the third constituted so small a percentage when the averages were figured that it was not considered.

To determine the reliability of the judgments of the nine instructors, the formula presented by Peters and Van Voorhis (11) was used. The predicted correlation between the average ratings of these instructors and the ratings to be expected from an infinite number of judges was found to be .909, indicating a rather high degree of reliability in the judgments of these instructors.

The books by Driver, Browne, and Ainsworth, *et al*, in this order, were the outstanding choices of the nine judges. Consequently, these three books, together with the official tennis rules guide of the National Section on Women's Athletics (10), were used in constructing the items in the test.

In preparing the items, each statement of information or each rule was written on a separate card, together with the source of the information and the page number. Wherever information contained in one text was at variance with that in another, the material was not used or the item was so constructed that the point of controversy was eliminated.

Three types of items were constructed: true-false, five-choice multiple choice, and five-response multiple response. The type of item used was determined by which seemed best suited to the material covered by each statement of information.

After the items were constructed, each was analyzed for sentence construction, conciseness, clarity, and importance to the objectives, using the check list presented by Adkins (1). The items then were criticized by two instructors of Tennis Methods courses. Test items were altered in accordance with their suggestions. Items as finally selected were distributed among the objectives corresponding rather closely to the percentage of emphasis ascribed to each objective by the average opinion of the nine judges.

The cards containing the 96 true-false items were sorted into three stacks, according to whether the items were judged to be easy, comparatively difficult, or difficult. Each stack was then shuffled so that a random sequence of correct answers would result. The 34 multiple response items were arranged arbitrarily in order of adjudged difficulty, and alternatives were so arranged that no particular pattern of correct answers resulted. For the 60 multiple choice items, a die was cast to determine the position of the correct response to each statement and items were arranged in order of adjudged difficulty. Since items were of the type suitable for machine-scoring, IBM forms 1000-B-108 and 1000-B-191 were used for recording answers.

Directions to students for answering the items, and a sample question and answer for each type item, were written and included on the test sheets. The test was then mimeographed. Directions for administering the test also were written and mimeographed.

At the time this study was conducted, the only available validated test of

tennis ability was the Dyer Backboard Test. The revision (5) of this test was selected for use in establishing achievement levels in tennis skill. A validity coefficient of .92 and a reliability of .92 for women physical education major students were reported for this test.

Questionnaires were sent to tennis instructors in 110 colleges and universities throughout the country, explaining the purpose of the study, and asking if the instructors would be able to administer the knowledge and skill tests to their women students who had completed or were completing the methods course in the Teaching of Tennis, or who had completed whatever courses in tennis were offered by their schools. A copy of directions for giving the revision of the Dyer Test, and a sheet for recording scores, also were sent, along with a stamped, self-addressed envelope for use in replying.

Completed questionnaires were returned by 63 schools. To the 49 institutions who indicated they would be able to give the knowledge test the first year, 802 copies of the test and answer sheet were sent. Special electrographic pencils for use in answering, a set of directions for administering the test, an answer key, and postage for returning the answer sheets also were sent.

A total of 381 completed answer sheets was returned from 27 schools. The answer sheets were machine-scored, with answers for the true-false and multiple response items being scored the number of items right minus the number of items wrong. Multiple choice items were scored the number of items correct. Before scoring, answer sheets were inspected to be sure that answer marks were definite, that erasures were complete, and that no stray markings had occurred. Approximately every tenth answer sheet was hand-scored as a check against the accuracy of the machine, to insure correct rheostat settings.

Since Kelley (7) has shown that the use of approximately 27 percent of scores at either end of the distribution will result in the most precise estimate of item validity, the 27 percent of papers with the highest scores and the 27 percent with the lowest scores were separated. Exactly 27 percent of the total number was but slightly more than 100, and since 100 is a convenient number to use, the 100 papers at either extreme of the distribution of scores were used in the item validation. The IBM Graphic Counter was used to tally the number of successes on each item for each group of 100 papers, and for the middle group of 181 papers.

The test consisted of 326 items. Scores ranged from 16 to 202. The mean of scores was 110.25 ± 1.62 (σ_M), and the standard deviation was 31.65.

Reliability of the scores was found to be $.93 \pm .004$. Froelich's (6) variation of the Kuder-Richardson formula was used to determine reliability.

To determine the validity of each item, the formula proposed by Votaw (14) was applied, using three probable errors to determine a significant difference between proportions of successes in highest-scoring and lowest-scoring groups. Any item shown to be invalid by the use of this formula was dropped from further consideration.

The difficulty rating of each valid item was found by determining the percentage of successes on the item, using the total 381 papers. The average difficulty level of all items on the revised test was 50.2 percent. The range of diffi-

TABLE 1
Difficulty Levels of Items on Revised Test

Percentage level of difficulty	Number of true-false	Number of multiple response	Number of multiple choice	Total
80–89	2	2		4
70–79	4	2	1	7
60–69	7	7	5	19
50–59	8	9	5	22
40–49	2	9	9	20
30–39	6		8	14
20–29	1		10	11
10–19		1	2	3
Total	30	30	40	100

culty was from 16.7 to 86.3 percent. Table 1 shows the number of each type of item on the revised test at each level of difficulty.

The difficulty rating of each valid item was placed on the card on which the item originally had been written, and the cards were arranged according to the objective covered by each. Selection of items then was made on the bases of difficulty rating and objective covered, since it was necessary to satisfy the objectives adequately and yet arrive at a test whose average difficulty was as near 50 percent as possible. It can be seen from Table 2 that the percentage of emphasis assigned to each of the objectives by the average of the judges' ratings is met adequately within the limits imposed by the length of the revised test.

Since multiple-choice items tend to be more reliable and more discriminating than the true-false type, multiple-choice items were selected in preference to true-false or multiple-response types, wherever it was posible to do so and still cover the objectives adequately and maintain an average difficulty of near 50 percent.

The length of the revised test was determined on several bases. A 100-item test is satisfactory in several ways. Both students and instructors are accustomed to tests of this length. Tests of 100 items add to the ease and accuracy of arriving at a student's score. This number is convenient in estimating the degree to which the objectives are met. Phillips (12) found that a comparable 100-item test could be completed by 97.5 percent of students in the customary 50-minute college class hour. On these bases it was decided to use 100 items in the revised form of the test.

The final form of the test consisted of 30 true-false, 30 three-response multiple-response, and 40 multiple-choice types of items. When this test was administered to 38 students, all but two had finished within 50 minutes and all had completed the test within 52 minutes.

Cards containing the items finally selected were sorted according to type of item, and those cards containing the true-false and multiple-choice items were arranged in increasing order of difficulty. It was not possible to do this with the multiple-response items since there was considerable variation in difficulty ratings among the three responses included in each grouping; the positions of

the three responses in each grouping were rearranged to some extent, to insure no set pattern of response.

TABLE 2

Distribution of Items on Revised Test According to Objectives

Objective	Average of judges' ratings	Number of items on test			
		T-F	M.R.	M.C.	Total
History	1.56	1		1	2
Equipment	2.78			3	3
Official rules	8.88	1		8	9
Etiquette	2.11	1		1	2
NSWA standards	1.78			2	2
Terminology	2.44			2	2
Ball spins	2.00	1		1	2
Grips	3.22			3	3
Technic of strokes					
Flat forehand drive	6.56	1	3	3	7
Flat backhand drive	6.89	4		2	6
Flat serve	3.11	2		1	3
Topslice serve	3.89	1	3		4
Other serves	.89			1	1
Lob	3.00	2		1	3
Smash	2.78	2		1	3
Volleys	3.50	1	3		4
Drives with spin	1.83			2	2
Drop shot	1.99	1		1	2
Half volley	.945	1			1
Strategy and tactics					
Doubles	5.22	3		2	5
Singles	4.78	1	3		4
Skills progression					
Beginners	7.11	1	6		7
Intermediates	6.33	2	3	1	6
Advanced	4.33		3	1	4
Tournaments	2.22	1		1	2
Skill tests	3.17		3		3
Knowledge tests	2.50		3		3
Officiating	2.55	2		1	3
Courts	1.67	1		1	2
Total	100.00	30	30	40	100

NOTE: T-F is true-false, M.R. is multiple response, M.C. is multiple choice.

For the multiple choice items it was necessary to be sure that each distractor functioned. Scott and French (13) state that, to be retained, a distractor should be selected by about three percent of those answering. Sufficient responses to each of the distractors in the 40 multiple choice statements were tallied until it was apparent that each had been selected by not less than three per cent of those responding. Revision of several foils appeared advisable. One distractor in each of four multiple choice items was altered to make it more attractive.

Instructions to students were drawn up, a sample question and answer for each type of item was written, and the test was mimeographed in its revised form. A separate answer sheet was designed and mimeographed, as was a set of directions for administering the test.[2]

[2] Qualified instructors may secure a copy of the test by writing the author.

A questionnaire, an explanatory letter, directions for administering the Dyer Test, and a stamped, self-addressed envelope were sent to 342 departments of physical education for women in colleges and universities throughout the country. Questionnaires were returned by 162 schools.

To the 72 institutions who indicated they would be able to administer the knowledge test, 1,099 copies of test and answer sheet were sent. A stamped, self-addressed envelope was included for returning the answer sheets. A total of 612 answer sheets was returned from 45 institutions.

The answer sheets were scored in two ways: (a) all items were scored the number of items right, and (b) the true-false and multiple response items were scored the number of items right minus the number of items wrong (correction-for-guessing formula), and the multiple choice items scored the number of items right.

The reliability of the test, when scored the number of items right, was found to be .788 ± .014. When the correction-for-guessing formula was applied, this reliability coefficient was raised to .900 ± .005. This indicates that, for this group of students, the correction-for-guessing formula should be applied, and the method of scoring should be: true-false and multiple response items scored the number of items right minus the number of items wrong, and the multiple choice items scored the number of items right.

This reliability formula (6) assumes that the test measures only one factor, that all item intercorrelations are equal, and that all items have the same difficulty rating. If these conditions are not fully met, the formula underestimates the reliability. Thus, for this group, one may be assured that the reliability is not less than .90 and probably is somewhat higher.

The scores on the revised test ranged from −1 to 94. The mean of scores was 38.0 ± .59 (σ_M) and the standard deviation was 14.73. *T*-scores and percentile ranks for the scores for this group of 612 students are given in Table 4.

Scores on the Revision of the Dyer Backboard Test of Tennis Ability were obtained for 672 women students, majoring in physical education, who had completed the course work in tennis offered by their schools. Scores ranged from 5 to 128, the average of scores being 45.5. Norms in the form of *T*-scores and percentile ranks appear in Table 5.

Table 3 provides an additional means for interpreting scores on both skill and knowledge tests. A standard deviation distance of 1.2 was used in determining these classifications.

TABLE 3

Classifications Based on Raw Scores for Knowledge and Skill Tests

Knowledge test (Raw score)	Classification	Skill test (Raw score)
66 and higher	Superior	79 and higher
48–65	Good	57–78
29–47	Average	35–56
11–28	Fair	13–34
10 and lower	Poor	12 and lower

TABLE 4
Norms for Tennis Knowledge Test

Raw score	T-score	Perc. rank	Raw score	T-score	Perc. rank	Raw score	T-score	Perc. rank
94	88	100	62	66	95	30	45	30
93	87	100	61	65	94	29	44	29
92	86	100	60	65	92	28	43	27
91	86	100	59	64	92	27	43	25
90	85	100	58	63	90	26	42	23
89	84	99	57	63	89	25	41	21
88	84	99	56	62	87	24	41	19
87	83	99	55	61	86	23	40	17
86	82	99	54	61	83	22	39	15
85	82	99	53	60	81	21	39	13
84	81	99	52	59	81	20	38	12
83	80	99	51	59	79	19	37	10
82	80	99	50	58	77	18	37	9
81	79	99	49	57	76	17	36	8
80	78	99	48	57	73	16	35	6
79	78	99	47	56	71	15	35	5
78	77	99	46	55	68	14	34	4
77	76	99	45	55	65	13	33	3
76	76	99	44	54	62	12	33	2
75	75	99	43	53	60	11	32	2
74	74	99	42	53	57	10	31	2
73	74	99	41	52	55	9	30	2
72	73	99	40	51	52	8	30	2
71	72	99	39	51	50	7	29	1
70	72	99	38	50	47	6	28	1
69	71	98	37	49	45	5	28	1
68	70	98	36	49	42	4	27	1
67	70	98	35	48	40	3	26	0
66	69	97	34	47	37	2	26	0
65	68	97	33	47	36	1	25	0
64	67	97	32	46	34	0	24	0
63	67	96	31	45	32	−1	24	0

NOTE: Perc. rank is percentile rank. N is 612.

Discretion is suggested when using the tables of norms. Considerable variation was found to exist in class time devoted to courses in Methods of Teaching Tennis. Instructors of these courses reported class hours available for the course ranging from 2 to 72 hours, the average being 16 class hours. It was not possible to determine the amount of instruction which preceded this course. Achievement to be expected of students should be based in part on opportunities for learning. Where group achievement is below desired levels, a critical consideration of all the course work offered in tennis may be indicated.

Summary

Achievement levels in tennis skill and knowledge were determined, based on the accomplishments of women students majoring in physical education, who had completed or were nearing completion of a course in Methods of Teaching Tennis.

To determine achievement levels in knowledge of tennis, a written test was constructed. The procedure followed was that recommended by authorities

TABLE 5

Norms for Revision of Dyer Backboard Test of Tennis Ability

Raw score	T-score	Perc. rank	Raw score	T-score	Perc. rank	Raw score	T-score	Perc. rank
128	96	100	86	73	97	44	49	50
127	96	100	85	72	96	43	48	46
126	95	100	84	71	96	42	48	45
125	94	100	83	71	96	41	47	42
124	94	100	82	70	96	40	47	40
123	93	100	81	70	95	39	46	37
122	93	100	80	69	95	38	46	34
121	92	100	79	69	95	37	45	32
120	92	100	78	68	94	36	44	29
119	91	100	77	67	94	35	44	26
118	91	100	76	67	93	34	43	24
117	90	100	75	66	93	33	43	20
116	89	100	74	66	93	32	42	18
115	89	100	73	65	92	31	42	16
114	88	100	72	65	92	30	41	15
113	88	100	71	64	92	29	41	14
112	87	100	70	64	91	28	40	13
111	87	100	69	63	90	27	39	12
110	86	100	68	62	89	26	39	11
109	85	100	67	62	89	25	38	10
108	85	100	66	61	88	24	38	9
107	84	99	65	61	87	23	37	8
106	84	99	64	60	87	22	37	7
105	83	99	63	60	86	21	36	6
104	83	99	62	59	85	20	35	6
103	82	99	61	58	84	19	35	5
102	82	99	60	58	83	18	34	5
101	81	99	59	57	81	17	34	4
100	80	99	58	57	79	16	33	4
99	80	99	57	56	77	15	33	3
98	79	99	56	56	76	14	32	3
97	79	99	55	55	74	13	32	2
96	78	99	54	55	72	12	31	2
95	78	98	53	54	70	11	30	1
94	77	98	52	53	68	10	30	1
93	76	98	51	53	67	9	29	1
92	76	98	50	52	64	8	29	1
91	75	98	49	52	62	7	28	1
90	75	98	48	51	59	6	28	1
89	74	98	47	51	57	5	27	0
88	74	97	46	50	54			
87	73	97	45	50	52			

NOTE: Perc. rank is percentile rank. N is 672.

in the field of test construction. Curricular validity was established by analyses of textbooks and courses of study, and by judgments of competent persons. Statistical validity of the 100 items on the revised form of the test was determined by use of the Votaw formula, using the highest-scoring and lowest-scoring 27 percents of the distribution of scores of the sample group of 381 students. A ratio of three times the probable error was the basis for determining a significant difference between proportions of successes in the two extreme groups.

Reliability of the test was found to be .90 when the correction-for-chance-success formula was applied in scoring. The average difficulty of all items on

the test was 50.2 percent and the range of difficulty was from 16.7 to 86.3 percent. Norms in the form of *T*-scores and percentile ranks, based on 612 individuals, have been provided.

To determine levels of achievement in skill in tennis, the revision of the Dyer Backboard Test of Tennis Ability was administered to 672 women students majoring in physical education in colleges and universities in all sections of the country. Norms in the form of *T*-scores and percentile ranks have been determined.

Conclusions

1. The tennis knowledge test for women physical education major students is valid, reliable, and objective.
2. A considerably higher reliability coefficient is obtained when the method of scoring is: true-false and multiple-response items, number of items right minus the number of items wrong, and the multiple-choice items, number of items right.
3. The test is administratively economical in time and cost of materials. Instructions to administrator and testee are clear, concise, and definite.
4. Tables of norms are provided for evaluating scores.
5. The knowledge test, in conjunction with the skill test, should enable instructors of courses in Methods of Teaching Tennis to judge the adequacy of preparation of their major students in this course.
6. Use of the knowledge and skill tests should be a valuable aid to instructors as a means for evaluation of their teaching and of the adequacy of the course work offered in tennis.
7. The knowledge and skill test norms will enable students to diagnose their strengths and weaknesses in this activity.
8. Norms as determined for both tests may provide a means of motivation toward improvement in accomplishment on the part of major students.
9. Both the skill and knowledge tests may be used as a guide to course work requirements.
10. Scores obtained on these tests may be used as one basis for assigning grades.
11. Results obtained from these tests, in conjunction with results from similar tests in other areas in the professional program, could be used in the advantageous placing of graduates in teaching positions.
12. Although the knowledge test was designed specifically for women students, it may be adapted easily for use in men's professional preparation groups.

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Initial Body Position and Total Body Reaction Time

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MANY SPORTS activities require sudden and rapid adjustments to the constantly changing stimuli of a game situation. From an upright position of alertness, an athlete is often required to shift his body position forward, backward, or to either side. For example, after watching an opponent dribble from the far end of the floor, a basketball player may be required to move forward or to either side. Depending upon a rapid change in the ball's position and the constantly changing configuration of 21 other players, a football back may be required to start forward, backward, or to one side or the other.

The importance of this ability in athletic performance has been indicated in a number of investigations (1, 2, 5). These reports uniformly emphasize that speed of body reaction, or total body reaction time, is related to athletic success. Although the preponderance of evidence leaves little doubt as to the value of a fast total body reaction time in athletics, it would seem that some possible aspects of the situation have been neglected. For the type of reaction under consideration, there appear to be no studies concerned with the effect of initial body position upon speed of total body reaction. Insofar as professional workers in athletics vary in their beliefs as to what constitutes the best upright body position for rapid movement, the problem merits exploration.

The study herein reported is concerned with the effect of initial body position upon total body reaction time. The variations in body position involved the distribution of body weight and the position of the knees. The four positions studied were:

A. Knees straight with weight distributed over feet.
B. Knees straight with weight on balls of feet.
C. Knees bent with weight distributed over feet.
D. Knees bent with weight on balls of feet.

No controls were placed upon the degree of knee bending; each subject was permitted to bend his knees to the degree he felt most comfortable and effective. In all four starting positions, the feet were parallel, the body was bent forward, and the hands were placed in front of the body.

Method

Apparatus. The apparatus consisted of two metal contact plates, a light stimulus, and a standard electric clock. The contact plates, 13 inches long and 6 inches wide, were mounted flush with the top of a low platform. The plates were positioned parallel to their long axes and 12 inches apart. This arrangement enabled a subject to stand on the plates with feet parallel and approxi-

mately the width of the hips apart. A micro-switch was placed under each plate so that when a subject stood upon the plate the switch was closed, and when a subject moved off the plate the switch was opened. The top of each plate was painted with a non-skid compound to prevent slipping during a series of reactions.

The visual stimulus to which a subject responded consisted of two 105–125 volt split plate neon glow lamps. The lamps were mounted 12 inches apart and placed so that they were 10 feet in front of the contact plates and 5 feet above the floor level.

The electrical circuit was wired in such a manner that the experimenter could simultaneously throw on either light and start a .01 second standard electric clock. Movement of a subject's foot off the correct contact plate broke the circuit and stopped the clock. When the light to the left came on, movement of the left foot stopped the clock; when the light to the right came on, movement of the right foot stopped the clock.

Procedure and Subjects. The total body reaction time was measured by having the subject stand on the contact plates in one of the starting positions described earlier. At the signal "Ready", the subject concentrated on the light panel directly in front of him. When one of the lights appeared, the subject stepped diagonally forward with the foot indicated by the visual stimulus. To assure movement of the entire body, a subject was required to step diagonally forward and place his hands on the edge of table located approximately 4 feet beyond the contact plates. The time interval between the signal "Ready" and the appearance of the light stimulus was systematically varied during a series of trials. These intervals were approximately 1, 2, and 3 seconds.

Twenty-five reaction time measures were obtained for each starting position. Before any series of trials, the experimenter gave a set of memorized instructions to the subject. The instructions were accompanied by careful demonstrations of the desired starting position, kind of reaction, etc. Following this, the subject was permitted to practice until it became evident that he understood the task required of him.

In all four starting positions, the sequence of response (left foot or right foot) was arranged in random order. Upon the completion of each group of 25 reactions, the subject was allowed to rest for approximately five minutes.

Sixteen male physical education majors of Indiana University served as subjects. Their ages ranged from 20 to 32 years.

Experimental Design. Since the experimental procedures involved repeated measures on the same subject, and since the order of the starting positions could conceivably be an important factor, it was decided that a Latin square analysis with replication of the same square would provide the maximum information. This technique makes it possible to isolate the variation attributable to order of starting position and to incorporate a test of significance for order of starting position, kind of starting position, and trials. The general procedure of the analysis has been described by Edwards (4).

In formulating the experimental plan, the subjects were divided at random into four groups of four subjects each. A set of four subjects constituted a

4 x 4 Latin square, with rows representing subjects and order of presentation of starting positions, columns representing successive trials, and cell entries representing the kind of starting position.

The Latin square arrangement used was drawn at random from a selected group of 4 x 4 squares presented by Cochran and Cox (3, *p. 119*). This square was used for each set of subjects, giving four replications.

Results

Before combining data from replicated Latin squares, Bartlett's test of homogeneity of variance was applied to the separate squares. The χ^2 obtained was not significant, and this was interpreted as supporting the hypothesis of random sampling from a population with a common variance.

The variance analysis of the combined data on total body reaction time under four starting conditions is summarized in Table 1. Although the general analysis is straightforward, the method of arriving at the appropriate error term for testing the significance of the correlated observations merits comments. It will be noted in Table 1 that this portion of the analysis contains two error terms. Since these estimates are both measures of the experimental error, they would not be expected to differ except within the limits of random sampling. That they do not is indicated by an F value of 1.19. For 33 and 9 degrees of freedom an F value of approximately 2.86 is required for significance at the 5 per cent level. In view of these results, the two residual mean squares were combined to obtain a pooled error mean square based upon 42 degrees of freedom. This pooled error mean square was used to test the mean squares for kind of reaction time and trials.

Abiding by the usual significance standards, it is seen in Table 1 that only the F value for kinds of reaction time is significant. The hypothesis that the differences in reaction time under four starting conditions could be attributed to chance was therefore rejected.

TABLE 1

Analysis of Variance of Total Body Reaction Time

Source of Variation	Sum of Squares	df	Mean Square	F	P
Independent observations:					
Order of presentation	277.250	3	92.417	—	
Residual between individuals	1224.250	12	102.021		
Total between individuals	1501.500	15			
Correlated observations:					
Kind of reaction time	476.375	3	158.972	20.60	Above 1%
Trials	62.375	3	20.972	2.69	Below 5%
Residual from Latin square (error)	60.375	9	6.708		
Residual within individuals (error)	263.375	33	7.981	1.19	Below 5%
Total within individuals	862.500	48			
Total for experiment	2364.000	63			

To determine which starting positions resulted in a significant difference in reaction time, t tests were applied to the obtained data. In making these tests, the estimated standard error of the difference between any two starting positions was obtained by the formula $\sqrt{2s^2/r}$, where s^2 is the mean square per unit and r the number of replicates (3, *p. 109*). The results of this analysis are summarized in Table 2.

From the t values obtained, it is evident that the reaction times fall into two groups: (1) the reaction times obtained with weight distributed over the feet and (2), the reaction times obtained with weight on the balls of the feet. In all comparisons the reaction times with weight distributed over the feet were significantly shorter than those with the weight on the ball of the foot.

In reference to the knee positions, it will be noted that in each weight distribution group the starting reaction time tends to be shorter in the knees bent position. These differences, however, were not significant, and it was concluded that the position of the knees had no marked effect upon reaction time.

TABLE 2

Comparisons of Total Body Reaction Time Under Four Starting Positions

Starting position	Mean (seconds)	Difference	S. E. Difference	t	P
K-S-W-F[1]	.5094				
K-S-W-B	.5525	.0431	.0190	2.368	Above 5%
K-S-W-F	.5094				
K-B-W-F	.4844	.0250	.0190	1.316	Below 5%
K-S-W-F	.5094				
K-B-W-B	.5488	.0394	.0190	2.074	Above 5%
K-S-W-B	.5525				
K-B-W-F	.4844	.0681	.0190	3.584	Above 1%
K-S-W-B	.5525				
K-B-W-B	.5488	.0037	.0190	0.195	Below 5%
K-B-W-F	.4844				
K-B-W-B	.5488	.0644	.0190	3.389	Above 1%

[1] K-S-W-F. Knees straight with weight distributed over feet.
K-S-W-B. Knees straight with weight on balls of feet.
K-B-W-F. Knees bent with weight distributed over feet.
K-B-W-B. Knees bent with weight on balls of feet.

Discussion

It was occasionally noticed during the course of the experiment that several subjects appeared to rock back on their heels in making a reaction. While this struck the experimenter as rather curious, nothing was thought of it at the time. However, when analysis of the data was completed, the casual observation appeared to offer possibilities of explaining the experimental results. If subjects actually did rock back on their heels during starting reactions, it is

not difficult to theorize as to why starting positions with the weight on the balls of the feet would result in slower reaction times. In these starting positions, the time required to bring the heels to the floor would be included in the reaction time. Obviously, lowering of the heels would not be involved in starting reactions with the weight distributed over the feet. To explore this possibility, all available subjects were recalled for further reaction time trials. Fourteen of the original 16 subjects were able to co-operate.

In the second series of trials, small metal disks were attached to the heels and balls of the feet. Each disk was wired to an individual marker of a Teledeltos polygraph recording unit. The arrangement was such that while any disk was in contact with the metal starting plates a mark was made on the Teledeltos paper. This procedure gave an objective record of the changes in weight distribution during a total body reaction under four starting conditions.

Typical records are illustrated in Figure I. With the exception of one subject, all starting reactions were initiated by rocking back on the heels to the extent that the balls of the feet were raised off the starting plates. Following this, the weight was shifted to the balls of the feet, and the reaction was completed. These latter shifts showed considerable variation; however, the most common pattern was one in which the weight was first shifted to the ball of the foot to be moved and was followed by a shift to the ball of the stationary foot.

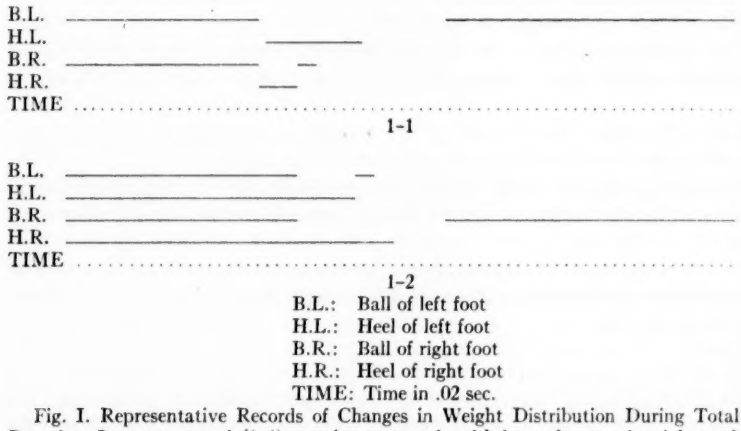

Fig. I. Representative Records of Changes in Weight Distribution During Total Body Reaction. In upper record (1–1) reaction was made with knees bent and weight on balls of feet. In lower record (1–2) reaction was made with knees straight and weight distributed over feet.

Only one subject did not consistently follow the general practice of rocking back on the heels in initiating his reactions. In 18 out of a total of 50 reactions from starting positions with the weight on the balls of the feet, this subject simply lowered his weight to the entire foot in starting his reactions. In all other trials, however, he did rock back on his heels.

Precisely why most subjects should consistently rock back on their heels in making a forward movement is, of course, unknown. In many respects it re-

minds the experimenter of the common observation that many of our actions or movements are preceded by what might be called back action.[1] In our writing movements, for example, we often precede the stroke which will start a letter with a short movement in the opposite direction. This can readily be seen in the little hooks that commonly occur at the start of a letter. Whether or not this type of behavior should be classified as a sort of preliminary movement is difficult to decide, for in many instances it seems to be without the purposes of the usual preliminary movement. This appears to be especially true in the case of rocking back on the heels.

Although no ready answer is to be found for the utilitarian value of rocking back on the heels in making a total body reaction, it is suggested that this behavior provides at least a partial answer for the reaction times found in this study. Starting reactions from the balls of the feet require more time because the time required to lower the heels to the floor is included in the reaction time.

Conclusions

1. The total body reaction time was measured under the following starting positions:
   A. Knees straight with weight distributed over feet.
   B. Knees straight with weight on the balls of feet.
   C. Knees bent with weight distributed over feet.
   D. Knees bent with weight on balls of feet.
2. The starting positions with the body weight distributed over the feet were significantly shorter than those positions with the weight over the balls of the feet.
3. For each weight distribution group, no significant differences were found for starting reactions involving the positions of the knees.
4. A post-experiment study of the changes in weight distribution revealed that most subjects consistently rocked back on their heels in completing a reaction.
5. It was suggested that starting reactions from the balls of the feet require more time because the time required to lower the heels to the floor was included in the reaction time.

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[1] An early study of this phenomenon has been reported by Williams (6).

An Experiment in Social Dance Testing

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A scientific measurement to determine the dancing ability of social dancers is needed in the field of physical education. According to Scott and French (4), ratings represent almost the only approach to measurement in dance, and they are used for evaluating ability in the various skills and types of dance. McCloy (3) states that at the present time there are no really satisfactory tests of rhythm which are both objective and sufficiently easy to administer to be practical.

The tests of sensory rhythm most widely used in research in physical education are the C. E. Seashore measures of musical talent. Two of these are of particular value in physical education, the one on sense of time and the one on sense of rhythm. Clarke (1) has listed several studies of rhythm tests in his book, but none of these are applicable to the field of social dance.

As a phase of academic teaching, it was necessary for the writer to evaluate his students as to their dancing ability. The existing measuring devices did not serve to fit the situation. Also, it was desired that subjective analysis be eliminated, and an objective measure be used.

Construction of the Test

The first step in the construction of a test was to ask Russell Danburg, Department of Music, University of Florida, if he would take a melody and play it in six different rhythms. His choice of melody was the old American folk ballad "Birmingham Jail," which was to be played in the rhythm of waltz, tango, slow fox trot, fox trot (jitterbug), rumba, and samba. Mr. Danburg wrote the orchestral score and then secured the services of a group of musicians, who recorded the six rhythms on a tape. This tape was then transcribed to a record so that the waltz, tango, and slow fox trot are on one side of the record, and the fox trot (jitterbug), rumba, and samba are recorded on the other side.

On the first side of the record the waltz is played for 26 measures, four of which are introduction; then a seven-second pause; then 34 measures of tango, two of which are introduction; then a seven-second pause; and then 18 measures of slow fox-trot, two of which are introduction. On the second side of the record the fox trot (jitterbug) is played for 22 measures, four of which are introduction; then a seven-second pause; then 38 measures of rumba, four of which are introduction; then a seven-second pause; and finally, 44 measures of samba, four of which are introduction.

Administration of the Test

The students are reviewed in each of the basic steps in the six rhythms to make sure that there is no confusion as to the particular step which is desired.

The starting point on the floor is marked with an *X* with a piece of white chalk. The students are instructed to do the waltz, slow fox trot, rumba, and samba in a "box." In the case of the tango, the students are to move forward doing the basic step, and then move back doing a basic step and return to the *X*. In the jitterbug, the basic step is done in the vicinity of the *X* so that the first step on the left foot for the boy and the first step on the right foot for the girl the student would be able to step on the *X* marked on the floor.

In scoring the student being tested, the scorer counts the number of steps taken in relation to the nearest basic step. The scoring is illustrated by the instructor doing the basic steps and having the students do the scoring.

The students are paired at random and each member given a 3-inch x 5-inch card and a pencil. The class is then instructed to put their partner's name on the first line in the upper left-hand corner, their own name in the upper right-hand corner on the first line, and then to number 1 to 6 along the left-hand side, each number occupying one line.

The students are then reminded that they are not to start the test until the introduction is played, and that the instructor will tell before a particular rhythm comes up what the rhythm will be and the number of measures of introduction.

The six scores are totaled for a final score.

Results

OBJECTIVITY

Sixty college men and women who had taken one semester of social dance, which consisted of two one-hour periods per week for 15 weeks, were given the test. For this purpose, the classes were divided into small groups of three so that one person would take the test and the other two people would score the testee independently. The range of ability of these students was greatly varied.

TABLE 1
Objectivity Coefficient of Correlations

1. Waltz	.932 ± .006
2. Tango	.678 ± .028
3. Slow Fox Trot	.973 ± .002
4. Fox Trot (Jitterbug)	.724 ± .024
5. Rumba	.872 ± .011
6. Samba	.457 ± .047
Total score	.792 ± .018

Following Garrett (2), the coefficient of correlation was calculated by the product-moment method for each of the six items and a total score was computed. The coefficients of correlation are presented in Table 1.

RELIABILITY

Fifty-four college men and women who had taken one semester of social dance, which consisted of two one-hour periods per week for 15 weeks, were

given the test on one day and then were re-tested two days later. Practice was not allowed between the two testing periods. The same instructor and scorer administered the test each time.

Following Garrett (2), the coefficient of correlation was calculated by the product-moment method for each of the six items and a total score was computed. The coefficients of correlation are presented in Table 2.

TABLE 2
Reliability Coefficient of Correlations

1. Waltz	.341 ± .060
2. Tango	.614 ± .036
3. Slow Fox Trot	.198 ± .074
4. Fox Trot (Jitterbug)	.355 ± .059
5. Rumba	.718 ± .026
6. Samba	.304 ± .064
Total score	.472 ± .048

VALIDITY

Fifty-two college men and women who had taken one semester of social dance, which consisted of two one-hour periods per week for 15 weeks, were used to establish the validity.

Prior to taking the test, two dancing instructors rated the students' ability. The procedure was to play popular dance recordings in the following rhythms: waltz, tango, slow fox trot, fox trot (jitterbug), rumba, and samba. During the first half of the record, the instructors rated the students as they danced individually. During the second half of the record, the instructors rated the students as they danced with a partner. For each rhythm there was an exchange of partners, so that no one danced with the same partner more than once. The instructors used a rating scale of 0–10, a score of 5 being considered as an average dancer. Each of the student's 12 ratings were added together to give a total score for that individual.

The final score for each student was obtained by averaging the scores of the two instructors. This final score was used as the criterion.

Correlation was computed by the Pearson Product-Moment Method (3), using the final score as obtained by averaging the two subjective rating scores of the instructors with the objective test score. The validity coefficient was .376 ± .080.

Discussion

In scoring the test, each individual obtains a score on six different rhythms. It is possible on each of the items to score less than the correct number or more than the correct number. With this type of scoring, it is possible to score under on one item of the test and over on another item of the test, which results in a distortion of the final score. For example, if a student scored a five on the waltz item with the correct score being six, and scored a seven on the tango item with the correct score being six, the total score of the individual would be 12 and the correct total score would be 12. There is an obvious fallacy in this

scoring, particularly if the student varies his interpretation of the tempo to the extent of being slow on some rhythms and fast on other rhythms.

A final score of less than the correct final score and a score of more than the correct final score were treated the same, depending on degree. With a score of one more and one less than the final correct score, the individuals were ranked as having the same score or same ranking; with a score of two more and two less than the final correct score, the individuals were ranked as having the same score or same ranking. Table 3 illustrates the method of ranking. Rank 1 was considered the best score, and rank 11 the poorest score.

The score of 76 in Table 3 is based on a forward basic step and a backward basic step being considered as "one complete basic step." The only exception is the fox trot (jitterbug), in which the basic step is considered as a complete basic step.

TABLE 3
Scoring Table

Final Score	Rank
76	1
75–77	2
74–78	3
73–79	4
72–80	5
71–81	6
70–82	7
69–83	8
68–84	9
67–85	10
66–86	11

Summary

The principal purpose of this experiment was to construct an objective social dance skill test. A musical score was written. A group of musicians had the music recorded on tape, which was then cut on a record. Service classes at the University of Florida were used in this experiment. For the objective phase of the test, 60 college men and women were scored by two independent scorers. For the reliability phase of the test, 54 college men and women were tested and retested, with a day in between the tests. For the validity phase of the test, 52 college men and women were scored subjectively as to their dancing ability by two instructors. The average score of the two instructors was used as the criterion.

Conclusions

1. The social dance test has an objectivity of .792 $\pm$ .018, a reliability of .472 $\pm$ .048, and a validity of .376 $\pm$ .080.
2. The practicability of the test was shown in the fact that the test is non time-consuming, and easy to administer.
3. The small initial cost of the record was the only expense involved in producing this test.

4. In an attempt to improve the objectivity and reliability of the test, a change in the administrative directions are to be made.

5. The reliability was low, indicating that the scoring was wrong or that the performers were inconsistent in their performance. This low reliability indicates that the validity of such a test cannot be established.

6. An investigation should be made to determine whether individuals are consistently slow in their interpretation of rhythm, or whether they are consistently fast in their interpretation of rhythm so as to improve the scoring technique.

7. Further investigation of the scoring system used in this test should be made to determine whether a better system could be devised to increase the reliability and validity of the test.

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A Study of the Effects of Prescribed Strenuous Exercises on the Physical Efficiency of Women[1]

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The physiological response of the organism to exercise, and the maximum work capacity of the individual have long been recognized as criteria for measuring physical efficiency.

A great deal is known as to the differences in physiological behavior of the fit as compared to that of the unfit individual and this, of course, gives us a basis upon which to judge the beneficial effects of exercise upon the human being.

The capacity to do work, while sometimes more easily measured than some physiological factors, is more subject to psychological factors, the most important one being, undoubtedly, that of motivation. However, a test that combines a measure of the two should give us a better insight into physical efficiency than one which measures only one.

Most of the studies as to the effects of exercise on the human subject have been done on men. Few studies have been done on women, and still fewer have been done on either men or women with respect to the lasting effects of any benefits thereby attained.

Purpose

It is, therefore, the purpose of this study to determine the effects of prescribed strenuous exercises on the physical efficiency of college women and to study the effects of detraining following such a series of exercises.

Physical efficiency may be defined as the capacity of the body to do work and its ability to maintain an effective homeostasis while doing so. The latter may best be elaborated by a quotation from Darling (2, *p. 141*), who bases his definition on fitness studies made during the World War II. He says, "Fitness, apparently, consists in the ability of the organism to maintain the various internal equilibria as closely as possible, to the resting state during strenuous exertion and to restore promptly after exercise any equilibriums which have been disturbed. In other words, effective homeostasis is a characteristic of fitness."

De-training, as used here, means the abstinence from the prescribed exercises used during the period of training, and the continuing of any usual activity

[1] This paper is based on experimental work submitted in partial fulfillment of the requirements for the degree of Doctor of Philosophy in the Department of Physical Education for Women at the State University of Iowa, 1951.

program. For some subjects it meant participating in a four-hour-a-week physical education program, and for others it meant no scheduled activity except that which they did for their own recreation.

Subjects

The subjects of the experiment were 23 healthy, young college women, ages 18 to 24. At the time of the pre-test all had been participating in a four-hour-a-week physical education program, and all but 8 continued in the four-hour-a-week physical education classes in addition to their prescribed exercise program. Two of the subjects were physical education majors, 15 were first and third year student nurses, and 6 were in the liberal arts program.

Procedure

TESTS AND THEIR ADMINISTRATION

The subjects practiced once on all of the tests within three days before they were given. This was to familiarize them with the procedure and to minimize any psychological effects which might result from inexperience with the equipment. The tests consisted of the following items and determinations and were given in the order reported.

I. *Grip Strength:* The maximum grip strength and strength endurance for the right and left hand respectively for one minute were recorded in pounds. The grip dynamometer for women and recording apparatus as described by Tuttle, Janney, and Thompson (11) were used.

II. *Treadmill:* This consisted of a moderately fast walk at the rate of 3½ miles per hour at an 8 per cent grade for 3 minutes on a motor driven treadmill.

A. *Description of the oxygen supply:* Oxygen was given to the subject by a modified Benedict-Roth respiratory apparatus. The spirometer was a special model constructed to hold 20 per cent more oxygen than the usual type of machine. The soda-lime tank was placed outside the spirometer. The spirometer was mounted on an electrically driven extension kymograph which revolved at 30 mm. per minute. When the spirometer did not hold enough oxygen to meet the requirements of the subject, it was refilled quickly and without interference with the subject. The oxygen consumption was computed in the manner described by Tuttle, Wilson, Daum and Rhodes (13).

B. *Measurements taken from the treadmill walk:*

1. Standing oxygen consumption in cc.
   This was taken with the subject standing on the treadmill for 3 minutes or until a uniform state was attained.
2. Working oxygen consumption in cc.
   This is the oxygen cost of a 3-minute walk on the treadmill.
3. Oxygen debt in cc.
   The oxygen debt was computed from the method described by Hill, Long and Lupton (7) and was the amount of oxygen used in complete recovery minus the amount used during the same period of time while at rest in the standing position.
4. Work efficiency
   This was computed from the total working oxygen consumption as calculated in B-2 above.

$$\text{Work efficiency} = \frac{\text{work done} \times 100}{\text{work equivalent of oxygen used}} = \%$$

Work done = weight of the subject in kilograms was multiplied by the distance the weight was lifted (in this experiment it was 22.54 meters), which gave kilogram meters of work.

Work equivalent of oxygen used in doing work = the corrected oxygen required to perform the work was multiplied by 2009.

Caloric equivalent of a liter of O_2 (assuming an R.Q. of 0.82) = 4.825

Work equivalent of 1 calorie is 426.7 Kg.-M $4.825 \times 426.7 = 2009$

5. Ventilation volume

This was the product in liters of the tidal air and the respiratory rate. The respiratory rate was found by measuring the number of respiratory excursions per minute. The tidal air was found in the following manner:

A line was drawn on the kymograph record parallel to the line of the oxygen slope and was the width of the respiratory excursion. A line was drawn for each minute. The width of the line was measured in millimeters and multiplied by the spirometer constant of 28.9. Ventilation volume was measured for each minute of the period of work and recovery, and an average for one minute computed.

6. Recovery time

This was expressed in minutes and represented the time that it took the individual to return to pre-exercise oxygen consumption rate.

7. Heart rate

This was taken by palpation at the radial artery. The pulse rate was taken for 15 seconds, until two consecutive readings gave the same results, multiplied by 4 and recorded as beats per minute.

a. Sitting

This was taken before the subject mounted the treadmill.

b. Standing

This was taken with the subject standing on the treadmill.

c. At the end of the 3-minute walk on the treadmill

The pulse rate was taken immediately at the end of the exercise for 10 seconds, multiplied by 6 and recorded as beats per minute.

d. At the end of recovery from exercise

When the subject had recovered from her oxygen debt, her pulse rate was taken.

III. *Bicycle Ergometer:* The bicycle ergometer as described by Tuttle and Wendler (12) was used for measuring work in this experiment. The subjects rode it for one minute at maximum work capacity. The field current was set at 3 amperes, so that when the pedals were turned at a rate of 60 rpm the work rate was 0.33 HP. The output of the generator was recorded in volts. The mean voltage generated per minute was calculated and the work accomplished for the minute converted into kilogram meters per minute by reference to the conversion table constructed for that purpose (see reference 12, *op. cit.*).

EXERCISES

Within three days following the pre-tests, the subjects were started on an exercise program, consisting of 7½ minutes to 12 minutes of strenuous exercises (see Appendix for typical day's program) daily for 11 consecutive days. The exercises involved two weekends; one Sunday the subjects reported to the gymnasium as usual, the other Sunday they performed, unsupervised, a prescribed set of exercises in their rooms. Because the subjects were run in four different groups, the unsupervised Sunday came at various times in the sequence. At all other times the subjects reported to the gymnasium where they were given the exercises under the direct supervision of the experimenter.

The exercises were designed mainly to increase cardio-respiratory endurance and to develop grip strength. To increase cardio-respiratory endurance, the

exercises were so directed that at all times the individual was working and was called upon to put forth her maximum effort. The exercises were all timed to the second and once the day's program was begun there was no lapse between one exercise and the other except the interval it took to change positions.

As a means of motivation, the subjects recorded the number of times they could do an exercise and were encouraged the next day to better their previous record.

POST-TRAINING

At the end of the training period, the subjects were divided into two groups, A and B.

The A group was tested one day following the end of training, and the B group two days after. This was to see if strenuous exercise preceding the day of a test reduced physical efficiency as measured by this experiment.

DE-TRAINING

The two groups were then tested each week for five weeks of de-training. The time of day that they were tested was kept consistent for each subject throughout the testing period.

The subjects were advised to continue in their normal routine of living during this period and to participate in any activity that they wanted to. The only thing they were asked to do was not to engage in any daily strenuous exercise program such as was used during the training period.

Results and Discussion

EFFECTS OF TRAINING ON PHYSICAL EFFICIENCY

Physiological Responses: The 5 per cent level of confidence was adopted as the criterion.

From Table 1 it is apparent that all physiological measures, with the exception of ventilation volume, were significantly improved as a result of training.

All physiological measures were taken from the 3-minute walk at 3½ miles per hour on the treadmill. This would be classified as a submaximal exercise.

In this experiment, the oxygen debt accumulated by any subject in any test was greatly under two liters, and for most subjects was less than one liter.

Since lactic acid is mainly acquired in debts of from three to four liters (10), it is apparent here that we are dealing with another method for incurring an oxygen debt. That there is another mechanism for the debt accumulated in moderate exercise and one responsible for part of the lactic acid debt is discussed and substantiated by Yanof (14) and others (8, 9). This debt has been referred to as the alactic acid debt.

In strenuous work, Margaria and Edwards (9) found that the alactic acid debt is about one-third of the total oxygen debt and is paid in five minutes or less. Henry (4, *p. 435*) speaks of it as the fast component of the lactic acid debt and he postulates, "it is a normal rather than emergency mechanism and is a necessary accompaniment of work." He states further (*p. 435*), "This type of

TABLE 1

Significance Level of the Effects of Training

Test	A Group		B Group		First Week		Second Week		Third Week		Fourth Week		Fifth Week	
	"t"	per cent	"t"	per cent	"t"	per cent	"t"	per cent	"t"	per cent	"t"	per cent	"t"	per cent
	N = 11		N = 12		N = 11		N = 22		N = 14		N = 20		N = 14	
Physiological														
Oxygen debt	2.27	5.0	6.39	0.1	1.75	20.0	2.70	2.0	*3.03	1.0	*0.40	70.0	*0.52	70.0
Pulse rate	3.30	1.0	2.95	2.0	3.31	1.0	2.36	5.0	0.17	90.0	1.56	20.0	*0.40	70.0
Work efficiency	3.21	1.0	3.50	1.0	4.97	0.1	7.07	0.1	1.16	30.0	1.06	40.0	2.64	2.0
Recovery time	4.44	0.1	5.26	0.1	6.88	0.1	7.21	0.1	0.14	90.0	*0.12	90.0	*1.40	20.0
Ventilation volume	1.73	20.0	*0.88	40.0	0.21	90.0	0.29	80.0	*0.06	60.0	*0.04	90.0	0.90	40.0
Performance														
Bicycle	1.16	30.0	*1.96	10.0	*1.33	30.0	*0.68	60.0	2.54	5.0	0.64	60.0	1.53	20.0
Right grip, maximum	0.35	80.0	0.43	70.0	3.78	1.0	2.46	5.0	1.46	20.0	2.32	5.0	1.47	20.0
Right grip, endurance	1.35	30.0	0.67	60.0	3.38	1.0	3.06	1.0	2.59	5.0	4.58	0.1	2.33	5.0
Left grip, maximum	2.02	10.0	2.17	10.0	1.89	10.0	1.64	20.0	1.24	30.0	0.81	50.0	0.28	80.0
Left grip, endurance	1.56	20.0	2.41	5.0	3.69	1.0	2.78	2.0	2.91	2.0	1.49	20.0	1.73	20.0

* Denotes a change in the less efficient direction during post-training and de-training from pre-training.

debt does not result from a lag in the circulation or other adjustments to the early phase of exercise—rather it is simply a reflection of the fact that oxygen consumption during exercise does not increase until there is a substrate to be oxidized and that substrate is formed as a result of work, hence requires time for accumulation."

The ability of the body to pay off this alactic acid debt appears to be related to the Krebs cycle, by which pyruvate is oxidized to CO_2 and H_2O, and its ultimate oxidation via the cytochrome system to H_2O and energy (4). It is this oxidative breakdown of pyruvic acid that generates the new energy-rich phosphate bonds. The results of Hill's (6) experiments on frog muscle promotes the hypothesis that the concentration of cytochrome oxidase is an important factor and one upon which the oxidative recovery from activity depends. He suggests that this system might play a part in determining the size of the recovery constant from oxygen debt in man.

Henry (4) found in his experiments that the size of the oxygen debt correlated .74 with recovery constant (large debts had slower recovery rates), whereas there was no correlation between rate of work as measured by metabolic cost and recovery constant. He found the amount of substrate to be a product of the work done and not an individual matter. However, the accumulation of the substrate, he concludes, is determined by the individual and his differences in recovery constants.

Thus it may be that we must look to the efficiency of the cytochrome oxidase system for the answer to the improved ability of the system to supply oxygen to the tissues as a result of training.

Since previous works show that training affects the responses of the individual to exercise more than it brings about a change in basal measures, only the pulse rate response to exercise was studied. Pulse rate, the first 10 seconds immediately following exercise, was taken as that most nearly paralleling the pulse rate during exercise. Cotton and Dill (1) found the pulse rate the first 10 seconds after exercise to vary only slightly from that during exercise, and that taken the second 10 seconds after exercise to decline about 6 per cent.

A lower pulse rate response to exercise indicates a better cardiac function and represents a greater stroke volume per beat, thus reflecting a more efficient mechanism for delivering blood to the working parts.

Performance: In maximum-work output measures (Table 1), only the left grip endurance strength index for Group B was significantly improved at the end of training. However, the raw score data showed all other changes, while not statistically significant, were in the direction of an improved response.

As has been previously stated, maximum work output is dependent in part upon psychological factors and the individual's subjective feelings of giving an all-out performance. Along with this it is interesting to note that of all tests, physiological and maximum work output, the bicycle which showed the least improvement was the most disliked test item, and grip strength the second.

EFFECTS OF DE-TRAINING ON PHYSICAL EFFICIENCY

Physiological responses: Further analysis of Table 1 reveals that with the exception of ventilation volume, all physiological measures showed an improvement lasting through the second week of de-training.

Pulse rate, recovery time, and work efficiency were as good after one week of de-training as they were at the end of training (Table 2). The reduction of the oxygen debt was greater for Group B at the end of training than it was after one week of de-training; for Group A it was as significantly improved one week after as it was immediately after training.

Work efficiency was higher at the end of the second week of de-training than it was at the end of training (Table 2). While oxygen debt showed no significant reduction the first week of de-training as compared to pre-training, but was improved the second week of de-training, it is evident from Table 3 that there is no difference between the first and second weeks of de-training.

TABLE 2

Measures Reflecting a Significant Change at the 5 percent Level

Test	1st Week	2nd Week	3rd Week	4th Week	5th Week
	Group	Group	Group	Group	Group
Oxygen debt	B P	B P	AB P^{opp}	A P^{opp}	AB P^{opp}
Ventilation volume	A P				B D^{opp}
Pulse rate		AB P	AB P	AB P	AB P^{opp}
Recovery time		B P	AB P	AB P^{opp}	AB P^{opp}
Work efficiency		AB D	AB P		A P
Bicycle					
Right grip, maximum	A D	A D			
Right grip, endurance	AB D	A D		A D	
Left grip, maximum		AB P	B P	AB P	AB P^{opp}
Left grip, endurance	A D	B P		B P	B P

P means efficiency is in favor of post-training.
D means efficiency is in favor of de-training.
opp shows less efficient status during de-training as compared with pre-training.

The third week of de-training begins to show the influence of other factors affecting various measures of physical efficiency. Oxygen debt was higher than it was before training, and all other tests showed no difference between pre-training and the end of the third week of de-training.

The fourth and fifth weeks of de-training show further the influence of other factors affecting physical efficiency (Table 2). The fourth-week oxygen debt and recovery time were higher than they were before training, and the fifth-week oxygen debt, ventilation volume, pulse rate, and recovery time were all higher than before training. Work efficiency is the only measure that was improved the fifth week of de-training compared to pre-training.

Since the weights of the subjects varied little from week to week, the external work done by each subject remained more or less constant each week. Work efficiency varied, however, and was the only physiological measure that showed

a greater improvement during the weeks of de-training over the end of training. An analysis of Table 3 shows us that it is as much improved the fifth week of de-training as the first week, more improved the fourth than the third, and the fourth week it is as high as the second, and higher than the first week. This would lead one to believe that there may be a slight training effect in walking on the treadmill which resulted in better coordination. It might also add further to Henry's (4) theory that the substrate is a product of work and not subject to individual difference.

TABLE 3

Measures Reflecting A Significant Change at the 5 percent Level When Weeks of De-Training Are Compared

Test	Weeks									
	1st and 2nd	1st and 3rd	1st and 4th	1st and 5th	2nd and 3rd	2nd and 4th	2nd and 5th	3rd and 4th	3rd and 5th	4th and 5th
Oxygen debt		1	1	1	2	2	2	4		
Ventilation volume										5
Pulse rate	1	1	1	1	2		2	4		4
Recovery time	1	1	1	1	2	2	2			4
Work efficiency	2	1	4		2		2	4	5	4
Bicycle	2	3	4	5	3	4	5	3	3	5
Right grip, maximum	1	1	1	1	2	2				
Right grip, endurance	1	1	1	1						4
Left grip, maximum	1		1	1		2	2	3	3	
Left grip, endurance	1	1	1	1		2	2	3	3	

Number indicates week that measures showed better efficiency.

Performance. Table 1 shows that only three performance tests—right grip maximum and endurance index, and left grip endurance index—show a consistent significant improvement during the weeks of de-training. The bicycle shows an improvement at the 5 per cent level the third week of de-training, and all other tests, with the exception of left grip maximum, show a change at the 2 per cent level or better lasting through four weeks of de-training, and through the fifth week in right grip endurance index.

As has been previously discussed, performance as measured by maximum work output is subject to psychological influences. The fact that performance shows such variance in results would lend support to this theory.

DIFFERENCES IN PHYSICAL EFFICIENCY BETWEEN GROUPS A AND B

Group A was tested one day after the end of the exercises, and Group B two days after training. From Table 4 it is apparent that the only difference in the two groups was in oxygen debt and left grip endurance index.

It is believed by some that giving an all-out performance, such as was done in the training period, affects physical efficiency by bringing on a state of exhaustion. Therefore, they recommend a day of rest before the final meet or performance that the individual is to give.

The inconclusiveness of the results of this experiment in regard to this and the small number of subjects tested each time suggest that this is an area which might warrant further research.

TABLE 4

Significance Level Between Post-Training Efficiency of Groups A and B

Test	N	"t"	Percent Level of Significance
Oxygen debt	21	*4.73	00.1
Work efficiency	21	0.26	80.0
Recovery time	21	0.13	90.0
Pulse rate	21	0.54	60.0
Ventilation volume	21	0.76	50.0
Bicycle	21	2.25	05.0
Right grip, maximum	21	0.61	60.0
Right grip, endurance	21	0.59	60.0
Left grip, maximum	21	0.99	40.0
Left grip, endurance	21	*2.59	02.0

* Group B had the more efficient status.

Summary

The effects of training and de-training on physical efficiency of 23 young college women were studied. The training period consisted of short bouts of strenuous exercises daily for 11 consecutive days. Physical efficiency was measured by physiological responses (oxygen debt, heart rate, work efficiency, and ventilation volume) to a moderate walk on the treadmill and by maximum work output on the bicycle ergometer and grip dynamometer. The following results were found:

(a) Training improved physical efficiency as measured by the above physiological responses of the body to exercise.
(b) The improvement in physical efficiency, as shown in the physiological measures, lasted through two weeks of de-training.
(c) Training effected no immediate significant change in physical efficiency as measured by performance tests (bicycle ergometer and grip dynamometer).
(d) Performance tests, with the exception of left grip maximum strength, showed a significant improvement during the weeks of de-training.

Conclusions

The results, based upon this study, appear to justify the following conclusions:

1. Short intensive training improves physical efficiency as measured by physiological response of the body to exercise.

2. The improvement in physical efficiency, as shown by the physiological measures and produced by the short series of exercises given in this experiment, lasts through two weeks following cessation of training.

APPENDIX

Typical Day's Program (Taken from the Seventh Day)

1. Warm-ups, 1 minute	
A. Rope-jumping movement	½ minute
B. Alternate trunk twisting	15 seconds
C. Trunk circling	15 seconds
2. Running back and forth across the gymnasium	1 ¾ minutes
3. Push-ups from the knees	1 minute
4. Burpee	1 minute
5. Partner sit-ups	½ minute
6. Partner pull-ups	1 minute
7. Squat position with alternate leg extension	1 minute
8. Running back and forth across the gymnasium	2 minutes
9. Alternate hopping combined with ball squeezing	1 minute
Total exercise time	10 ¼ minutes

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Stratified Sampling in Determining Significant Differences in Recreational Participation Among Students in Institutions with Unlike Curricula[1]

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SCIENTIFIC investigation applied to the field of *Recreation Education* (17, 18) is comparatively new; this is true because the field, as a profession, is young. Recreation, like many other professions during their early stages, has drawn much of its personnel from related professions and many of its principles from related fields. This was done, perhaps, with the hope that in time recreation education would develop more and more of its own personnel and guiding principles out of which should come better and more desirable research undertakings, directed toward worthy goals and measurable evidences of growing maturity (2). This is a challenge to the products of the various recreation curricula in colleges and universities (19).

Within recent years, a number of questions have arisen in the field of recreation. These questions should be answered by scientific inquiry. For instance, one may ask, "If differences exist in recreational interests and also in actual recreation participation between students in institutions with unlike curricula, how significant are these differences? What are the factors affecting these differences?" Another may press this problem a bit further: "Do differences exist in recreation interests and also in actual recreation participation among each of the four academic classes of students in the same institution? What are the factors affecting these differences? If no significant differences exist in either case one or in case two, how may one account for the homogeneity or for *the unique* variance of the groups?" (2, 7, 8, 13).

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[1] Part of these data was used in a thesis, *A Study of Recreational Activities and Interests of Undergraduate Students in Negro Institutions of Higher Learning in North Carolina 1950–1951*, in partial fulfillment for the Master of Arts degree at the North Carolina College at Durham, Durham, North Carolina. The thesis was directed by the senior author and written by the junior author.

NOTE: *Recreation Education* is interpreted in this presentation as follows: (1) recreation instruction, (2) recreation service, (3) recreation status of the environment, and (4) research in recreation—measurement and evaluation.

Purpose of Study

It is seldom possible to study more than a part of the whole or the universe in which one may be interested (14). In this investigation, such was the case. Therefore, the purpose of this study was to determine, by a stratified sampling technique (5), the extent to which significant differences exist in actual recreational participation[2] between students in two different institutions with unlike curricula.

Developing the Instrument

After a careful study was made of the various classifications of recreation areas of activities, the classification in use by the National Recreation Association was selected as the basic instrument to be used in this investigation. The National Recreation Association's classification of activities was chosen on the basis of its comprehensiveness and adaptability (1).

After the list of activities was chosen and arranged in a checklist form, the checklist was administered to a 10-per-cent sample of each of the four academic classes (each stratum) in two different liberal arts institutions; namely, Shaw University and North Carolina College at Durham. The findings from these two preliminary tests did not reveal any significant differences between these two samples drawn from two known *unique populations* (students in two liberal arts curricula) in two different institutions (3, 4, 6, 9, 15, 16).

This procedure suggested several things to the investigators: (a) that the instrument adequately covered the range of recreation activities in which Negro college students actually participated; (b) that the instrument is fairly reliable when used in the stratified technique of taking at least a 10-per-cent sample of each of the strata of the universe; (c) that the extent of likeness and/or unlikeness of two populations could be determined relative to actual participation in recreational activities; and (d) that it could be determined whether or not this difference were significant (10, 11).

Procedure

For this study, better than a 10-per-cent sample was drawn from two populations with unlike curricula—the Agricultural and Technical College of North Carolina and the Winston-Salem Teachers College. Personal visits were made by the investigators to each of the institutions chosen for this study and the checklist was administered by them to a sample of each of the four classes—Freshman, Sophomore, Junior, and Senior. In each institution, students filled out the checklist under the supervision of the investigators during the same time and under the same conditions.

To avoid any observable skewness of data, it was necessary for the investigators to take a cross-section of the various divisions of the different classes (12, 13). For example, in the Freshman class, where there were four of five

[2] Three factors determined the student's extent of *actual participation* in a recreational activity: Namely, (1) his knowledge of the activity, (2) his skill in the activity, and (3) he must actively take part in the specific activity at least once a month during its season.

divisions which had been established on the basis of Freshman orientation tests in English, it was necessary to select a random sample of each division and yet avoid duplication. This was more of a problem with the Freshman and Sophomore classes, where the divisions were more numerous.

Limitations of Study

This investigation was limited to students enrolled in the Agricultural and Technical College of North Carolina and to students enrolled in the Winston-Salem Teachers College.

Table 1 shows student enrollment by class, selected number, and percentage used in stratified sampling of the two institutions.

TABLE 1

Student Enrollment by Class, Selected Number, and Percentage Used in Stratified Sampling of Two Institutions

Agricultural and Technical College of North Carolina

	Student enrollment			Selected sample			Percentage of sample		
Sex	M	F	T	M	F	T	M	F	T
Freshmen	402	227	629	45	41	86	11.2	18.1	13.7
Sophomores	343	171	514	40	38	78	11.7	22.2	15.2
Juniors	358	115	473	36	21	57	10.1	18.3	12.1
Seniors	385	96	481	39	14	53	10.1	14.6	11.0
Total	1488	609	2097	160	114	274	10.7	18.7	13.1

Winston-Salem Teachers College

	Student enrollment			Selected sample			Percentage of sample		
Sex	M	F	T	M	F	T	M	F	T
Freshmen	64	130	194	15	20	35	23.4	15.3	18.0
Sophomores	60	89	149	10	10	20	16.6	11.2	13.4
Juniors	36	62	98	10	9	19	27.8	14.5	19.4
Seniors	32	73	105	10	13	23	31.2	17.8	21.9
Total	192	354	546	45	52	97	23.2	14.7	17.8

Composite

	Student enrollment			Selected sample			Percentage of sample		
Sex	M	F	T	M	F	T	M	F	T
Freshmen	466	357	823	60	61	121	12.9	17.1	14.7
Sophomores	403	260	663	50	48	98	12.4	18.3	14.7
Juniors	394	177	571	46	30	76	11.7	16.9	13.0
Seniors	417	169	586	49	27	76	11.8	16.0	13.0
Total	1680	963	2643	205	166	371	12.2	17.2	14.0

NOTE: M—Number of *male* students enrolled in institution by classes. F—Number of *female* students enrolled in institution by classes T—*Total* number of students enrolled in institution by classes.

TABLE 2

A Comparison of Participation in Activities between the Agricultural and Technical College of North Carolina and Winston-Salem Teachers College

Activities	Freshmen						Sophomores						Juniors						Seniors					
	A & T		W-S		Dif.	CR	A & T		W-S		Dif.	CR	A & T		W-S		Dif.	CR	A & T		W-S		Dif.	CR
	Avg.[1]	Per-cent	Avg.[1]	Per-cent			Avg.[1]	Per-cent	Avg.[1]	Per-cent			Avg.[1]	Per-cent	Avg.[1]	Per-cent			Avg.[1]	Per-cent	Avg.[1]	Per-cent		
Active games and sports																								
Male	9.1	20.2	4.8	32.0	11.8	.88	8.5	21.2	3.3	33.0	11.8	.73	11.2	31.1	3.5	35.0	3.9	.23	10.5	26.9	2.7	27.0	1	.01
Female	10.1	24.6	2.5	12.5	12.1	1.21	5.1	13.4	.9	9.0	4.4	.42	2.8	13.3	1.6	17.8	4.5	.31	1.2	8.6	2.2	16.9	8.3	.65
Arts and crafts																								
Male	6.2	13.8	1.1	7.3	6.5	.78	.84	2.1	1.0	10.0	7.9	.81	4.7	13.1	1.5	15.0	1.9	.15	4.0	10.3	1.5	15.0	4.7	.38
Female	5.6	13.7	2.5	12.5	1.2	.13	5.1	13.7	.9	9.0	4.7	.44	3.1	14.8	1.6	17.8	3.0	.20	1.2	8.6	2.2	16.9	8.3	.66
Collecting																								
Male	3.6	8.0	2.3	15.3	7.3	.72	7.0	17.5	.72	7.2	10.3	1.02	3.4	9.9	2.0	20.0	10.1	.74	5.9	15.1	1.1	11.0	4.1	.36
Female	8.1	10.8	2.9	14.5	5.3	.53	6.4	16.8	1.6	16.0	.8	.06	5.3	25.2	1.7	18.9	6.3	.39	4.9	35.0	1.7	13.1	21.9	1.39
Dancing																								
Male	3.6	8.0	1.9	12.7	4.7	.52	3.9	9.8	1.9	19.0	9.2	.69	6.2	17.2	2.2	22.0	4.8	.33	5.4	13.8	2.1	21.0	7.2	.51
Female	6.5	15.9	3.4	17.0	1.1	.11	4.6	12.1	2.1	21.0	8.9	.63	3.7	17.6	2.9	32.2	14.6	.82	3.4	24.3	1.6	11.4	12.9	.89
Dramatics																								
Male	4.6	10.2	1.8	12.0	1.8	.19	2.7	6.8	.79	7.9	1.1	.12	4.5	12.5	2.3	23.0	10.5	.73	3.8	9.7	1.2	12.0	2.3	.21
Female	7.4	18.0	3.1	15.5	2.5	.25	4.9	12.9	1.2	12.0	.9	.08	2.5	11.9	1.9	21.1	9.2	.60	2.2	13.3	1.8	13.8	.5	.38
Mental and linguistic																								
Male	5.6	12.4	3.9	26.0	13.6	1.1	4.2	10.5	2.1	21.0	10.5	.77	9.5	26.4	3.4	34.0	7.6	.46	10.2	26.2	2.5	25.0	1.2	.08
Female	14.8	36.1	4.9	24.5	11.6	.95	8.7	22.9	2.6	26.0	6.9	.45	8.8	41.9	2.9	32.2	9.7	.51	4.1	29.3	3.5	26.9	2.4	.14
Music																								
Male	4.5	10.0	3.8	25.3	15.3	1.26	3.8	9.5	1.5	15.0	5.5	.45	8.1	22.5	1.8	18.0	4.5	.32	6.2	15.6	2.2	22.0	6.4	.45
Female	8.2	20.0	3.2	15.0	4.0	.39	5.6	14.7	1.9	19.0	4.3	.31	4.5	21.4	2.0	22.2	.8	.05	1.7	12.2	1.8	13.8	1.6	.13
Nature and outing																								
Male	13.2	29.3	7.3	48.7	19.4	1.33	17.0	42.5	3.5	35.0	7.5	.50	12.4	34.4	5.4	54.0	19.6	1.11	14.5	37.2	2.9	29.0	8.2	.50
Female	14.1	34.4	7.1	35.5	1.1	.07	11.9	31.3	3.0	30.0	1.3	.08	9.8	46.7	3.3	36.7	10.0	.52	9.3	66.4	3.3	25.4	41.0	2.36[2]
Social																								
Male	10.9	24.2	6.8	45.3	21.1	1.48	16.2	40.5	3.1	31.0	9.5	.57	12.6	35.0	4.8	48.0	13.0	.74	17.4	44.6	3.3	33.0	11.6	.69
Female	19.1	46.6	7.6	38.0	8.6	.71	13.3	35.0	5.2	52.0	17.0	.97	10.8	51.4	4.4	48.9	2.5	.13	10.2	72.9	5.3	40.8	32.1	1.77

[1] The average extent to which the associated groups have actually participated in the activities listed and classified.

[2] A critical ratio of 1.96 is significant at the 5% level according to Fisher's test of significance.

Table 1 reveals that 2,643 students were enrolled in the Agricultural and Technical College of North Carolina and the Winston-Salem Teachers College. Of this number of students enrolled in the two institutions, 1,680 were men and 963 were women.

From the number of men students enrolled in the four academic classes of these two institutions, 205 or 12.2 percent were selected as an adequate and representative sample.

From the women students enrolled in the four academic classes of the two institutions, 166 or 17.2 percent were selected as an adequate and representative sample.

The over-all sample included 371 students or 14.0 percent of the total enrollments of the two institutions.

Table 2 shows the extent to which actual participation in recreational activities differs among students in institutions with unlike curricula.

Findings

Critical Ratios. As was previously indicated in Table 1, data presented in Table 2 were obtained from 274 students who represented 13.1 percent of the total undergraduate student enrollment of the Agricultural and Technical College of North Carolina and from 97 students who represented 17.8 percent of the total student enrollment of the Winston-Salem Teachers College. On the basis of the sample presented herein, the following observations were made:

1. For the most part, there do not appear to be significant differences between students enrolled in institutions with unlike curricula (Agricultural and Technical College of North Carolina and the Winston-Salem Teachers College) in their actual participation in a college recreation program sponsored by the Department of Physical Education.

2. In only one instance did there appear to be a significant difference. This difference appeared at the Senior level among the girls only in the area of Nature and Outing Activities. The critical ratio in this case was 2.36. A critical ratio of 1.96 is significant at the 5-per-cent level according to Fisher's Test of Significance (7).

3. It is likely, however, that institutional requirements in the core curriculum or in over-emphasis in certain recreation areas will influence student participation in these areas. This may account for the extent to which the difference exists between the Senior girls at the Agricultural and Technical College of Greensboro, North Carolina, and the Senior girls at the Winston-Salem Teachers College.

4. Generally, one would be led to believe that as students advance academically in years, there appears to be the tendency for their participation in recreation areas to be more homogeneous in selection (9).

Recommendations

It is recommended:

1. That further study be made in an effort to determine significant differences in recreation interests in relation to actual participation of students in institutions with unlike curricula.

2. That further study be made in an effort to determine significant differences in recreation interests and actual participation among persons enrolled in the *trade industry* and those enrolled in the *liberal arts curriculum.*

3. That a study be made of the factors which determine significant differences in interests and actual recreation participation in institutions with unlike curricula.

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Research Abstracts

Prepared by the Research Abstracts Committee of the National Council of the Research Section, *Paul A. Hunsicker, Chairman*

Anatomy and Physiology

1. GORDON, EDWARD E. Energy costs of various physical activities in relation to pulmonary tuberculosis. *Arch. Physic. Med.*, **33** (4): 201–209 (April 1952).

Tests were carried on with 13 normal and four tubercular patients. The open circuit method for metabolism estimation was used. Energy cost of various activities common to occupational therapy were studied. They included: making belts, leather and copper tooling, carving, and use of looms. A table of energy cost for various activities is given.—*Peter V. Karpovich.*

2. HIRSCHBERG, GERALD G. AND M. NATHANSON. Electromyographic recording of muscular activity in normal and spastic gaits. *Arch. Physic. Med.*, **33** (4): 217–224 (April 1952).

Method and apparatus for recording the muscular activity during walking and patterns of gait in normal and abnormal conditions are described. This method permits objective evaluation of effectiveness of therapy to relieve spasticity. It was observed that in the hemiplegic patient, there was a striking similarity of muscular contraction pattern between the non-paretic and paretic limbs.—*Lora M. Ewing and Peter V. Karpovich.*

3. HUBLER, WILLIS L., G. M. HIGGINS, AND J. F. HERRICK. Influence of the pituitary-adrenal axis on the hemogram of febrile white rats. *Arch. Physic. Med.*, **33** (7): 391–398 (July 1952).

Hyperthermia induced eosinopenia, lymphopenia, and neutrophilia in intact male rats but did not cause eosinopenia or lymphopenia in adrenalectomized rats. Hypophysectomized rats, on the other hand, showed same trends following hyperthermia as intact animals, but quantitatively eosinopenia and lymphopenia were less marked. Since neutrophilia was induced in adrenalectomized and hypophysectomized but not in hypophysectomized-adrenalectomized animals, it is postulated that either adrenocortical hormone or pituitary induce outpouring of neutrophils into peripheral blood. Adrenal medulla is not essential to neutrophilic response to elevated body temperature.—*Lora M. Ewing and Peter V. Karpovich.*

4. EBEL, ALFRED AND L. H. WISHAM. Effect of massage on muscle temperature and radiosodium clearance. *Arch. Physic. Med.*, **33** (7): 399–405 (July 1952).

The subjects were tested with Leeds & Northrop multiple-channel electric recording thermocouple "Speedomax." Results showed massage not effective in increasing muscle temperature and blood flow to muscle, only one subject showing any significant rise following massage. None of the seven subjects tested by radiosodium technique showed increased muscle circulation following massage. Value of massage for increasing skin circulation was confirmed. A slight increase in skin temperature, lasting only several minutes, was also observed in opposite limb, probably reflex in nature.—*Lora M. Ewing and Peter V. Karpovich.*

5. FRICKE, FRED J. AND J. W. GERSTEN. Effect of contrast baths on the vasomotor response of rheumatoid arthritis patients. *Arch. Physic. Med.*, **33** (4): 210–215 (April 1952).

At room temperature of approximately 24.5 to 25.0°C, average cutaneous temperature of rheumatoid arthritis patients was the same as normal controls. Decrease in cutaneous temperature, following immersion of hand in 15°C water for 1 minute, was greater in arthritis patients and the rate of return to normal slower. Contrast baths to hands of arthritis patients

decreased fall of temperature after cold stimulus but did not appreciably change rate of return to pre-cooling temperature.—*Lora M. Ewing and Peter V. Karpovich.*

6. TANNER, JAMES MOURILYAN. The effect of weight-training on physique. *Am. Jr. Phys. Anthrop.*, **10:** 4 (Dec. 1952).

Ten healthy young men underwent a course of physical training by weight-lifting over a period of approximately 4 months. Twenty anthropometric photographs were taken twice before training began, every three weeks during training, and 4 months after training had ceased. The largest gain was in upper arm and forearm circumferences which increased significantly in nearly all subjects; the upper-arm average increase was 2 cm. Four months after cessation of training, almost all measurements had reverted to the pretraining values; the remainder had nearly reached pre-training figures. The changes in shape of the limbs are discussed, the degree to which this training could upset anthroposcopic and anthropometric somatotyping, and the relative growth potentials of muscles in various parts of the body.—*The Wistar Institute.*

7. VAN HERREVELD, ANTHONIE. Re-innervation of paretic muscle by collateral branching of the residual motor innervation. *J. Comp. Neur.*, **97:** 2 (Oct. 1952).

Considerable functional improvements may occur in muscles from which part of the innervation has been removed, even when the conditions are such that no regeneration of the original innervation can take place. Abundant collateral branching of the motor fibers was observed in terminal motor nerve branches of partially denervated rabbit's sartorius muscle. The outgrowing collaterals grow into empty neurilemmal tubes which guide the fiber to deneurotized end-plates where they form terminal structures. The formation of collaterals starts as early as 4 to 5 days after the partial denervation of the muscle and continues through the first month. The collateral formation is not restricted to the terminal branches but was also found in the large intra-muscular branches of the motor nerve. The re-innervation by collateral branching of muscle fibers which lost their motor innervation together with muscle hypertrophy account for the functional improvements observed.—*The Wistar Institute.*

8. TROTTER, MILDRED AND GLESER, GOLDINE C. The estimation of stature from long bones of American Whites and Negroes. *Am. J. Phys. Anthrop.*, **10:** 4 (Dec. 1952).

Regression equations for estimation of living, adult stature of American Whites and Negroes of both sexes from single- and multiple-paired long bone lengths are presented. Data from which these equations were derived include (1) measurements of cadaver stature and of dry bones of 792 male military personnel and (2) measurements of cadaver stature and of dry bones of 855 subjects of both sexes of the Terry Anatomical Collection of Washington University. Comparable equations derived from the two sources of data were tested against each other and were found to be in agreement after the cadaver statures had been converted to maximum living statures. By extrapolation, similarly converted data from the female cadavers provide equations for estimation of living adult stature. Data from 100 additional White male military personnel were applied to pertinent equations developed in this study and in earlier studies by other investigators. The present equations resulted in estimates of stature with less deviation from the measured statures than did the equations of the other investigators. Equations applicable to bones of the lower limb give more accurate estimates of stature than those applicable to bones of the upper limb and the equation utilizing the combined length of femur and tibia gives the most accurate estimate.—*The Wistar Institute.*

9. HOWARD, RICHARD (M.D.) AND GERTLER, M. (M.D.). Axis deviation and body build. *American Heart Journal*, **44:** 35–42 (July 1952).

Routine electrocardiograms, including standard leads checked by unipolar limb leads, were taken on 144 men who did not show any clinical or laboratory evidence of heart disease. The axis deviation in degrees in each individual was determined from the standard limb leads by direct measurement on an Einthoven Triangle. Each subject was photographed and somatotyped by the method proposed by Sheldon and Associates. Other body measurements were taken. Coefficients of correlation were computed between the axis deviation and various

Anthropometric measures. Results indicate (1) no significant correlation between axis deviation and (a) height or (b) sternal ensiform measurements; (2) moderately significant negative correlations ($p > 0.05$) between axis deviation and (a) chest depth and (b) chest ratio; (3) highly significant correlations between axis deviation and (a) chest width and (b) weight, and a highly significant positive correlation with the ponderal index.—*J. Grove Wolf.*

10. RENBOURN, E. T., AND ELLISON, J. MCK. Some blood changes in old age. *Human Biology,* **24** (2): 57–86 (May 1952).

A clinical and statistical study was conducted over a number of years on 140 presumably healthy English people ranging from 60 to 104 years of age. Data from younger groups were presented for comparative purposes. The results of the study indicated that the haematocrit value was not significantly different from that of the young group. The erythrocyte sedimentation rate increased with age but the change is appreciably smaller in the more physically fit individuals. The osmotic fragility of the red blood corpuscles, the systolic and pulse pressure is somewhat greater with age. Little change was noted in diastolic pressure. The blood cholesterol and whole blood chloride did not change. Blood area concentration is somewhat raised and area concentrating ability lowered in elderly individuals. No sex differences were found.—*D. B. Van Dalen.*

Health

11. SMALL, JAMES C. (M.D.). Saving arthritic hands. *Today's Health,* **30:** 23, 56 (April 1952).

Arthritis occurs nine times as frequently in women as in men. Known facts are: (1) The manner in which arthritis attacks is the earliest indication of the type of the disease; (2) Its progress, if not treated, follows a predicted pattern; and, (3) A few simple exercises may do much to prevent deformity and maintain usefulness of the hands. The two great types are rheumatoid arthritis and osteoarthritis. Squeezing of a rubber ball is about the worst hand exercise for rheumatoid arthritis. Exercise recommended is to spread the fingers and attempt to straighten them with as much force as possible. Maintain this effort for about 20 seconds. The benefits arise from the effort made, and not from the amount of movement accomplished. —*J. Grove Wolf.*

12. MILLMAN, MAX (M.D.). Common pitfalls in reducing. *Today's Health,* **30:** 47, 56–57 (May 1952).

The most common pitfall in reducing is the careless choice of a diet. Other forms of "nutritional faddism" which should be shunned are the diets which consist of: One or two items to the exclusion of all others; the liquid diet such as milk, the soup or the fruit juice diet; the indiscriminate use of patent medicines; and the injurious use of exercise in weight reduction of the obese individual. The surest way to avoid faulty treatment is to make certain the source of information on which it is based is authentic and reliable. The treatment of obesity calls for sound medical supervision.—*J. Grove Wolf.*

13. LERRIGO, MARION D. Stories in bone. *Today's Health,* **30:** 36–39 (June 1952).

X-ray films of a child's hand and wrist compared with a standard, thus finding the child's skeletal age (or stage of bone development), will tell the doctor much about the child's past, present, and future growth. These standards are based on x-ray films of growing children in the Brush foundation collection started in 1927 by Dr. T. W. Todd. Dr. S. I. Pyle, Western Reserve University, published these standards in 1950, in the "Radiographic Atlas of Skeletal Development of the Hand and Wrist." The standards show the stages of bone development in children at intervals of three months in the first year, six months from one to five years, and yearly up to 18 years. Useful clues to the child's health history pertaining to damage from illness, malnutrition, or other disturbances are reflected in the bony structure development.—*J. Grove Wolf.*

14. LAIRD, DONALD A. Intelligence and heredity. *Today's Health,* **30:** 23, 31 (Aug. 1952).

Children of the same family seldom differ more than 15 per cent in intelligence. Twins

differ only half as much. Although intelligence runs in a family, it does not run uniformly. Sir Francis Galton was the first to recognize the biological law of retrogression—the offspring tend to be more like the average of the race than their parents.—*J. Grove Wolf.*

Psychology and Education

15. Amatora, Sister May. Boys' personality appraisals differentiate teacher groups. *School and Society*, **76** (1970): 184–187 (September 20, 1952).

Nearly 1,500 boys ranging from the 4th through the 8th grades in the State of Indiana were appraised by their respective teachers on the Child Personality Scale. The "t" technique was employed to analyze the data. It was found that the best ratings were those of the teachers 30–34 years of age. The ratings of the younger teachers were more favorable than the older educators. Plotted on a curve, the results would be that a normal distribution, with the peak at the 30–35 age group level.—*D. B. Van Dalen.*

16. Oxtoby, Toby, Mugge, Robert, and Wolfe, Dael. Enrollment and graduation trends from grade school to Ph.D. *School and Society*, **76** (1973): 225–231 (Oct. 11, 1952).

Data on school enrollments and graduations on a ten-year interval covering the past 30 years have been compiled. On the basis of current birth figures, the authors project enrollments and graduations for each year for all school levels as far into the future as available data will permit.—*D. B. Van Dalen.*

17. Bryan, A. Hughes and Greenberg, B. G. Methodology in the study of physical measurements of school children. *Human Biology*, **24** (2): 117–144 (May 1952).

This study was a methodological investigation to determine whether children drawn from presumably different populations differed significantly in their median age of onset of the somatic changes characteristic to puberty. Three methods of computing the immaturity points (logits, probits, and Karber's technique) on small samples of children were utilized. Karber's method was found to compare favorably with the other methods of calculation. Three limitations to the use of Karber's method were also set forth.—*D. B. Van Dalen.*

18. Harlow, Robert G. Masculine Inadequacy and Compensatory Development of Physique. *Journal of Personality*, **19:** 3 (March 1951).

Weightlifters were observed, on a subjective basis, to exhibit certain characteristic personality traits; some of these observations were in line with findings of Thune (*Research Quarterly*, Oct., 1949). In terms of psychoanalytic theory, Harlow deduced several specific psychological factors which would account for the desire of large and growing numbers of men to accentuate the uniquely masculine attribute of highly developed physique. On the basis of certain psychological and anthropological studies (Mead and Fenichel), he reached the theoretical conclusion that due to the predominance of mother influence and the paucity of father influence during the developmental years, it is necessary for American boys to contend with a femininity of conscience within themselves and an absence of masculine identification that is historically peculiar. This circumstance has given rise to psychological conflict in the male, with the result that certain compensatory behaviors manifest; among these is frequently found a tendency in men to emphasize physique in an effort to prove their masculinity to themselves and to others. In line with this reasoning, the weightlifter would be assumed, for example, to have strong feelings of masculine inadequacy, to be in need of establishing his maleness, to be comparatively narcissistic, to feel inferior and to have strong and rather generalized feelings of rejection and hostility derived from the early conflict over feminine identification.

A group of 20 habitual weightlifters was compared with a group of 20 non-lifters on the basis of two projective types of personality tests, the TAT and Sentence Completion. The differences between the groups, as indicated by 18 variables, consistently confirmed the initial psychoanalytical assumptions as to personality traits of weightlifters, in most instances significantly. The author concluded that the cultural shift which has reduced the influence of the father in the American home has given rise to a strongly felt compensatory need in large numbers of men, and that weightlifting helps many to meet this need.—*Warren R. Johnson.*

Recreation

19. BEDGER, JEAN E. How much do you know about your campers? *Camping Magazine*, **24:** 2: 12–13 (Feb. 1952).

A questionnaire was mailed to 263 camps in Illinois and Indiana to determine how many camps used information blanks to obtain knowledge of their campers. The camps surveyed were asked to send copies of any such blanks used in their programs. The findings of the study were based on an analysis of the 184 returns received.

The findings indicated that every respondent used an application blank of some kind, and many kept a health record. Other types of forms used included personal information cards; counselor's anecdotal records; staff, school, and parent questionnaires; personality analyses; and activity preferences. Many of these forms were designed to give a complete picture of the camper, his interests, achievements, personality traits, etc. Others aspired to somewhat less information, and a few were so brief as to suggest that the director was overlooking the possibilities inherent in such records. Many camps kept excellent records, followed through with the material and used it to good advantage. Some camps issued post-camp analyses based on these reports. The common features of the various forms received were as follows: name of camper; address; telephone number; and name and occupation of parents or guardian. The investigator concluded that developing the child into a well-rounded integrated personality can be greatly aided by keeping and using clear-cut records.—*Jackson M. Anderson.*

20. Competitive athletics for boys under twelve. *Recreation*, **45:** 9: 489–491 (Feb. 1952).

A questionnaire was distributed to all recreation executives in the nation. Its purpose was to determine the general practices of recreation departments in conducting competitive sports and athletic programs for boys under 12 years of age. A further purpose was to get the current thinking of recreation executives on the various aspects of competition for the under-12 group. The findings of the survey were based on an analysis of the 304 returns received. Some findings of the study were as follows: (1) a heavy majority of recreation departments approved competition on either an intra-center or city-wide basis for a number of activities, provided these activities are conducted with adequate controls; (2) most departments use some modification of playing areas for the major sports; (3) a majority of departments say that it is not the general practice for teams in this age group to wear any special uniform for intra-center or city-wide competition; (4) among those departments reporting partial or full uniforms for some or all activities, the greatest sources of funds for the purchase of these uniforms are from community and business groups and local merchants; (5) although a majority report desirable results from having boys wear uniforms, a considerable number feel that special outfits have undesirable effects upon them, upon the extent of participation, and upon the boys not so equipped.—*Jackson M. Anderson.*

21. Recreation planning principles and agency functions. *Recreation*, **45:** 8: 441–442 (Jan. 1952).

A survey report of recreation in metropolitan Madison, Wisconsin, contains a number of statements which have wide application and are of unusual significance. They deal with basic objectives and principles and, therefore, merit the attention of all who are concerned with recreation in the community. The report lists the following implications for recreation planning if a better environment is to be created by the constructive forces of the community: (1) every community should provide adequate outdoor and indoor areas and facilities to supplement the needs of families for play space; (2) every community should strive for the recapturing of a sense of belonging to a congenial neighborhood, where mutually-supporting social relationships prevail; (3) every community should seek to maintain a reasonable balance between opportunity for passive and active forms of recreation; (4) organized services and facilities in the community should be concerned about special areas of need where gross inequalities of recreational opportunity exist; (5) both public and private resources should be mobilized to provide ample opportunity for children and adults to have healthy outdoor experiences in natural surroundings; (6) leisure-time services need to be concerned about controversial issues, especially as they relate to the well-being and survival of the people; (7) campaigns in every community should be launched continuously for education of tastes and for development of discrimination in the use of commercialized diversion.—*Jackson M. Anderson.*

Guide to Authors

IN LINE with the over-all goal of making Association publications yield the greatest value to the individual and the profession, the following is a guide for the preparation of research manuscripts. The information below recognizes general techniques being employed by research publications similar to the *Research Quarterly*. When copy is prepared in accordance with these instructions, all Association research studies will follow a standard style.

Manuscripts

Manuscripts should be sent to the Editor (AAHPER, 1201 Sixteenth Street, Northwest, Washington 6, D. C.), who will see that each one is read by at least three members of the *Research Quarterly* Board of Associate Editors. On the basis of the three reviews, the Editor will advise the author as to the suitability of the paper or the desirability for revision. Papers are not judged by arbitrary standards but on their content of new research results in the field of physical education, health education, and recreation, presented with the greatest brevity compatible with scientific accuracy and clarity.

Since three members of the Board of Associate Editors review an article, it is requested that three clear copies of the manuscript be submitted in order to facilitate reviewing. A fourth copy of the article should be retained by the author. Only one copy of any charts, photographs, drawings, graphs, or similar illustrative material need be submitted. However, since such material must be sent to each reviewer in turn, more time must be allowed for the reviews.

Typewritten manuscript should be double-spaced on white paper of ordinary weight and standard size (8½ x 11 inches).

The sheets of manuscript should be kept flat and fastened with clips which can be removed easily. The pages of the typewritten copy should be numbered consecutively in the upper right-hand corner.

Paragraphs should be numbered consecutively throughout the manuscript, to facilitate ease of reference in case of revision.

Headings

The article should be arranged so as to indicate relative values of heading and subheadings.

Usually four gradations are sufficient: (a) article title, (b) first subhead appearing in boldface aligned left on page (underscored in manuscript with wavy line), (c) second subhead (if necessary) appearing in small caps aligned left on page, (d) third subhead, to appear in italic (underscored in manuscript), not centered, but run in at the beginning of the paragraph or section.

All headings should be typed in lower case with initial capitals, except for (c) above, which should be typed in capital letters.

Documentation

FOOTNOTES

Footnotes are not to be used for references or literature citations. They are rather used for the purpose of acknowledgment, special explanation, supplementary information, etc. (*See examples below.*)

Type footnotes (if any) on separate sheets, as many footnotes as convenient being written on a sheet. Footnotes should be numbered from 1 up for each article; a corresponding numeral appearing in the text. Asterisks should not be used.

Examples of Footnotes:

[1] This study was made under the direction of Dr. Arthur T. Slater-Hammel in the Research Laboratories, School of Health, Physical Education, and Recreation, Indiana University, Bloomington, Indiana.

[2] All measurements of the hand were recorded in centimeters and height was recorded in inches. The hand measurements were taken by Everett and reliability coefficients of above .90 were found for each measurement used in the study.

[3] For their wholehearted co-operation in facilitating collection of the data, special gratitude is extended to Superintendent Clarence Hines and the 1950–51 principals of the Adams, Condon, Edison, Francis Willare, Harris, Howard, Lincoln, River Road, and Whiteaker schools.

CITATIONS OF LITERATURE

Citations of literature should be segregated alphabetically by author's last name at the end of each article, under the caption of "REFERENCES." *Do not treat them as footnotes.* (*See above.*)

The literature citations, listed alphabetically, should be numbered consecutively, their location in the text being indicated by corresponding numbers written in full size and enclosed in parentheses: for example, (1) (2, 3). If there are several references in the text to a citation, the specific pages may be indicated thus: (1, *p. 117*) (1, *pp. 162–3*).

A uniform style should be maintained in writing citations. Do not enclose titles of chapters and articles in quotation marks. Italicize (underscore in manuscript) names of books and periodicals, bulletins, etc. (*See examples below.*)

Uniform sequence of data should be observed, as follows: *For a book*—Author's name (last name first); title of article or chapter; name of book; place of publication; publisher; year date; number of pages or specific pages referred to. *For a periodical*—Author's name (last name first); title of article or chapter; name of periodical; volume number; page numbers; year date; specific pages (if any).

Examples of References Appearing at End of Article:

1. American Association for Health, Physical Education, and Recreation, Health Education Division, Suggested Platforms for Health Education, *Journal of the American Association for Health-Physical Education-Recreation*, **18:** 436 (Sept. 1947).

2. American Association of School Administrators. *Health in Schools.* Revised edition. Washington, D. C.: the Association, a department of the National Education Association, 1951. pp. 266–7.
3. Deaver, G. G., Exercise and Heart Disease. *Research Quarterly,* **26:** 24–34, 1939. p. 26.
4. Ogden, Jean, and Jess Ogden. *Small Communities in Action.* New York: Harper & Brothers, 1946. 244 pp.
5. Potter, John Nicholas. *Physical Fitness of Junior High School Boys.* Unpublished Master's thesis, University of California, Berkeley, 1942. 39 pp., p. 15.

Tables

Each table should have a descriptive heading and should be specifically referred to in the text by number, *e.g.*, "Table 10," etc., never as "the above table" or "the following table." Number tables from 1 up for the entire manuscript, using Arabic numerals.

Tables should be double-spaced typewritten, like the rest of the material in the manuscript. They should be typed on separate sheets, as the printer will set them on a different machine from the one used for the text matter. If a table continues on a second sheet, it is not necessary to repeat the boxheads, the printer repeating when necessary from the original boxheads.

The word "TABLE" should be written in capital letters, as: "TABLE 1"; the table title should be written in lower case letters with initial capitals, and centered over the table. Tables should be ruled as desired, except that no rules will appear at the extreme right and left edges of the table. No double rules are to be used, unless necessary for clarity.

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Illustrative material is of two types: pen and ink drawings, which are reproduced by the line engraving process; and photographs, wash drawings, stipple drawings (in short anything containing shading), which are reproduced by the halftone process.

Line engravings are always treated as text figures and should be so designated. All drawings should be made with India ink, preferably on white tracing paper. If graph paper is used, a blue-lined paper must be chosen, as all other colors will make the graph lines appear in the background; sometimes it is desirable to ink in inch squares so that the curves can be more easily read.

Lettering should be plain and large enough to reproduce well when the drawing is reduced to the dimensions of the printed page ($4\frac{1}{8}$ x 7 inches). Most figures can be advantageously drawn for a linear reduction of one-half or one-fourth. Explanatory lettering should be included within the chart. Do not use gummed letters, for they are easily lost.

Care should be taken not to waste space, as this means greater reduction and a less satisfactory illustration. Often it is possible to combine several curves in one figure and thus not only save space but enable the reader to make comparisons at a glance. Legends can often be included within the chart and a considerable saving in space thus effected.

Halftones are treated as figures and should be so designated. Frequently, several halftones can be grouped to form an attractive full page, in which

case they should be numbered consecutively, in Roman numerals. Photographs should be in the form of clear black and white prints on glossy paper. Care should be taken to see that they cannot be bent or folded in handling *and paper clips should not be used.* All imperfections in the original copy are reproduced.

Figures should each be numbered consecutively from I up for the entire manuscript. Use Roman numerals to number figures, and Arabic numerals to number tables. The legends for the illustrations should be typed upon a separate sheet placed at the end of the manuscript. Care should be taken to indicate plainly in the text the exact location of all illustrations and tables.

The Association will assume complete engraving expense.

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Use Arabic figures for all definite weights, measurements, percentages, and degrees of temperature (for example: 2 kgm., 1 inch, 20.5 cc., 300°C.). Spell out all indefinite and approximate periods of time (for example: over one hundred years ago, about two-and-one-half hours). For numerals used in a general sense, spell out numbers through ten and use Arabic figures for 11 and over (seven times, five years old, 11 students).

ABBREVIATIONS

The metric system being in universal usage, standard abbreviations should be used whenever the weights and measurements are used with figures, i.e., 10 kgm., 6.25 cc., etc. The forms to be used are: cc., kgm., mgm., mm., l., and m. *Gram* should be spelled out in all cases to avoid possible confusion with *grain.* All obscure and ambiguous abbreviations should be avoided. Spell out English weights and measures (for example: ounce, pound, inch, foot, yard, mile). Preserve uniformity in all abbreviations.

Per cent should be two words. Use per cent sign (%) in tables or when it appears in parentheses in text.

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The author will receive his original manuscript and any engraver's proofs with the galley proofs of his article for correction. A reprint order blank will be enclosed for the author's convenience.

Errors that are discrepancies in transcription from the manuscript should be marked in *red* ink; any changes from copy should be marked in *black* ink. These two classes of errors are handled at the printer's by different operators.

Authors should be sure to answer all queries addressed to them on the proof. Any instructions to the printer should appear on the proof itself. If instructions are too extensive to write on proof, they may be embodied in a letter. Instructions and answers to queries should be circled to avoid the possibility of mistaking them for new copy.

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